Where older people walk:
Assessing the relationship between physical environmental factors and walking behavior of older adults

A Dissertation
Presented to
The Academic Faculty

by

Anjali Joseph

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy in the
College of Architecture

Georgia Institute of Technology
May 2006

Where older people walk:
Assessing the relationship between physical environmental factors and walking behavior of older adults

Approved by:

Dr. Craig Zimring, Advisor
School of Architecture
Georgia Institute of Technology

Dr. Sonit Bafna
School of Architecture
Georgia Institute of Technology

Dr. Harold W. Kohl
Centers for Disease Control and Prevention
School of Architecture
Georgia Institute of Technology

Date Approved: 3/27/06

ACKNOWLEDGEMENTS

It has been a long journey to get to this destination and I could have never made it without the support, encouragement and advice from my family, teachers, friends and others. I owe a special thanks to those who helped me in the research and writing of this dissertation and to those who made this study possible.

Most of all, I thank Craig Zimring for being a challenging guide, mentor, friend and collaborator during my years at Georgia Tech. He introduced me to the field of active living with all the opportunities for multidisciplinary thinking and collaboration. His support and advice for my intellectual and professional endeavors has been invaluable.

I also thank Sonit Bafna for opening my eyes to how architecture may support active living through some deeper underlying characteristics of building layouts. His help in using space syntax tools was invaluable in the analysis and visualization of structural path characteristics. I am indebted to Bill Kohl for his insightful comments on the drafts of this thesis, especially in using the appropriate statistical methods and in representing the results from this study.

I am extremely grateful to the Active Living Research and the Robert Wood Johnson Foundation for funding my dissertation and providing access to the cutting edge research in this multidisciplinary active living field through conferences and other venues. The grant has provided me the opportunity to focus on my research work and to be a part of a larger community of researchers and practitioners.

My thanks also to Kristen Day and Phil Sparling, my external examiners, for their active support and advice. Kristen Day's work with the elderly and with active living has been an inspiration to me and the Irvine Minnesota Tool developed by her team helped me develop the framework for this study. I also thank Phil Sparling for his comments on the importance of tying up my study findings to practical real world application.

I am also grateful to Paula Peche who made sure that I had all the resources I needed, be it water, binders or office space, to complete this work. I appreciate her help in putting together the dissertation grant and managing the many different aspects of it.

I also thank the administrators, staff and residents at the three case study facilities for their willingness to participate and to facilitate the different aspects of the study.

I would also like to thank Zongyu Zhang for his timely work in developing the space syntax extension to GIS program which was invaluable in conducting the morphological analysis and in visualizing path and path use characteristics. There are other friends – too many to name here – who by their presence, patience and encouragement provided me the support and impetus I needed to complete this thesis.

I am grateful to my parents, Mariamma and T.J. Joseph and my siblings Tessie, Anil and Shalini for their ongoing support, love and encouragement during this work and any other I have ever attempted.

Finally, I thank the two most important people in my life – my husband Nitin and my son Manav, for their love, continued inspiration, cajoling, nudging and unflagging support and encouragement. They bring laughter and humor into my life and prevent me from taking myself too seriously. Being with Manav is always an effective stress reliever. Nitin has this uncanny ability to never see the cloud but always the silver lining, and for that I am extremely grateful.

TABLE OF CONTENTS

Page

ACKNOWLEDGEMENTS…………………………………………………………..iii

LIST OF TABLES…………………………………………………………………ix

LIST OF FIGURES……………………………………………………………….xiv

SUMMARY………………………………………………………………………..xix

CHAPTERS

1 INTRODUCTION……………………………………………………………....1

2 ACTIVITY FRIENDLY ENVIRONMENTS FOR OLDER ADULTS……..7

2.1 The importance of walking for older adults……………………………. 8

2.2 Components of an activity friendly environment……………………….11

2.3 The role of the environment…………………………………………….19

2.4 Summary and discussion………………………………………………..27

3 OUTLINE OF RESEARCH…………………………………………………. 29

3.1 The context: Continuing care retirement communities…………………38

3.2 Population studied……………………………………………………….31

3.3 Unit of analysis…………………………………………………………. 31

3.4 Case study selection……………………………………………….... 35

3.5 Research design………………………………………………………….39

3.5.1 Path use for walking………………………………………………….40

3.5.2 Environmental characteristics of walking paths…………………..46

3.5.3 Campus organizational characteristics and demographics………..55

3.6 Analysis………………………………………………………………….56

3.6.1 Statistical analysis……………………………………………………56

3.6.2 Analysis of highly used path segments……………………………………58

3.6.3 Analysis of highly used routes………………………..………………58

4 DESCRIPTION OF CASE STUDIES……………………………………………..60

4.1 Case Study 1: PS Continuing Care Retirement Community………...60

4.1.1 Physical description…………………………………………………60

4.1.2 Resident characteristics……………………………………………...64

4.1.3 Social environment…………………………………………………64

4.1.4 Organizational environment…………………………………………65

4.2 Case Study 2: LV Continuing Care Retirement Community………...66

4.2.1 Physical description…………………………………………………66

4.2.2 Resident characteristics……………………………………………...70

4.2.3 Social environment…………………………………………………..71

4.2.4 Organizational environment…………………………………………72

4.2 Case Study 3: PV Continuing Care Retirement Community……….. 73

4.3.1 Physical description…………………………………………………73

4.3.2 Resident characteristics……………………………………………...76

4.3.3 Social environment…………………………………………………77

4.3.4 Organizational environment…………………………………………77

4.4 Summary…………………………………………………………………..79

5 CASE STUDY 1: PS RETIREMENT COMMUNITY…………………….. 82

5.1 Introduction……………………………………………………………. 82

5.2 Survey respondent characteristics and path use characteristics…….. 84

5.2.1 Survey respondent characteristics…………………………….. 84

5.2.2 Path use characteristics……………………………………………...85

5.3 Environmental factors………………………………………………. 89

5.3.1 Local path characteristics……………………………………90

5.3.2 Relational path characteristics………………………………..122

5.3.3 Global path characteristics…………………………………133

5.4 Analysis of high use path segments………………………………...140

5.5Analysis of highly used recreation routes…………………………...148

5.6 Summary of PS case study……………………………………….155

6 CASE STUDY 2: LV RETIREMENT COMMUNITY……………………165

6.1 Survey respondent and path use characteristics…………………….165

6.1.1 Survey respondent characteristics…………………………….165

6.1.2 Path use characteristics………………………………………. 166

6.2 Environmental factors……………………………………………… 170

6.2.1 Local path characteristics……………………………………. 171

6.2.2 Relational path characteristics………………………………..200

6.3.3 Global path characteristics…………………………………209

6.3 Analysis of high use path segments……………………………….. 213

6.4 Analysis of highly used recreation routes…………………………. 222

6.5 Summary of LV case study………………………………………227

7 **CASE STUDY 2: LV RETIREMENT COMMUNITY……………………235**

7.1 Survey respondent and path use characteristics…………………….235

7.1.1 Survey respondent characteristics…………………………… 235

7.1.2 Path use characteristics……………………………………….236

7.2 Environmental factors ………………………………………….. 240
7.2.1 Local path characteristics…………………………………. 241
7.2.2 Relational path characteristics………………………………..264
7.3.3 Global path characteristics……………………………………271
7.3 Analysis of high use path segments……………………………….. 278
7.4Analysis of highly used recreation routes…………………………...285
7.5 Summary of PV case study………………………………………289

8 **DISCUSSION AND CONCLUSION………………………………………. 297**
8.1 Comparison of case study findings…………………………………298
8.1.1 Path use for walking to destinations…………………………298
8.1.2 Path use for recreational walking……………………………. 302
8.2 Designing retirement communities for active living………………. 321
8.3 Strengths and limitations……………………………………………... 326
8.3 Future research directions……………………………………………..328

APPENDIX A: Data collection instruments and supporting documents……………331
APPENDIX B: Frequency distribution for path segment use……………………….....385
REFERENCES………………………………………………………………………390

LIST OF TABLES

Page No.

CHAPTER 3:

Table 3.1: Characteristics of a representative sample of non-profit CCRCs in the United States (Joseph, et al., 2006) 30
Table 3.1: Comparison of case study sites with nationwide sample of CCRCs 36
Table 3.3: Operational measures for studying where people choose to walk for recreation and to get to a destination 40
Table 3.4: Local and relational path characteristics assessed using the path assessment checklist 49

CHAPTER 4:

Table 4.1: Comparison of characteristics of three case study campuses 79

CHAPTER 5:

Table 5.1: Characteristics of PS survey respondents 84
Table 5.2: Number and percentage of path segments that were used/ not used for getting to destinations and for recreation by different categories of residents 87
Table 5.3: More indoor path segments were used over outdoor path segments for getting to destinations at PS 91
Table 5.4: Outdoor path segments were used over indoor path segments for recreational walking at PS 93
Table 5.5: Distribution of path segments on PS by length of segment 93
Table 5.6: More long segments were used for recreational walking at PS 95
Table 5.7: Distribution of indoor path segments by location 96
Table 5.8: More path segments between resident apartments were used compared to other indoor path segments 97
Table 5.9: More path segments between resident apartments were used for recreational walking as compared to other indoor path segments 98
Table 5.10: Distribution of outdoor path segments at PS based on location of segment . 99
Table 5.11: More sidewalk segments were used for walking for recreation at PS. 100
Table 5.12: A higher percentage of path segments with street crossings were used for recreational walking 104
Table 5.13: More path segments without steps were used for walking to destinations at PS 106
Table 5.14: More path segments without steps were used for walking for recreation at PS 107
Table 5.15: More continuous path segments were used for walking to destinations as compared to disjointed path segments 109
Table 5.16: More continuous path segments were used for recreation as compared to disjointed path segments 110

Table 5.17: More path segments without amenities were used for recreational walking 112
Table 5.18: Types of destinations along path segments at PS 112
Table 5.19: More path segments with activity-related destinations along them were used for walking to destinations at PS 115
Table 5.20: More path segments with residences along them are used for recreational walking...... 116
Table 5.21: More path segments with parking were used for recreational walking...... 118
Table 5.22: Number of destinations present along path segments at PS. 119
Table 5.23: More path segments with one or more destinations along them were used for walking to destinations at PS 120
Table 5.24: More path segments with one or more destinations along them were used for recreational walking at PS 121
Table 5.25: More path segments with many different types of views were used for recreational walking as compared to path segments with few views 123
Table 5.26: Types of views that can be seen from path segments at PS...... 124
Table 5.27: Fewer path segments *with* views to residential areas were used for walking to destinations 124
Table 5.28: More path segments with views to water were used for walking to destinations at PS 127
Table 5.29: More path segments with no views of tended nature were used for walking to destinations at PS 128
Table 5.30: More path segments with views to public places were used for walking to destination at PS...... 129
Table 5.31: More path segments with views to artwork were used for walking to destinations at PS 131
Table 5.32: More central path segments were used for walking to destinations as compared to path segments that were less central 135
Table 5.33: More central path segments were used for walking for recreation at PS as compared to path segments that were less central. 136
Table 5.34: Path segments that were part of more routes on campus were used more for walking to destinations 137
Table 5.35: More path segments that were part of many routes on campus were used for recreation...... 138
Table 5.36: Number of residents who chose different route for recreational walking at PS 149
Table 5.37: Number of cottage and apartment residents that walked to destinations at PS 156
Table 5.38: Local, relational and global path characteristics are related to path use for getting to destinations and for recreation at PS. 160

CHAPTER 6

Table 6.1: Characteristics of LV survey respondents 165
Table 6.2: Path use for walking among different categories of residents...... 169

Table 6.3: More indoor path segments segments were used for getting to destinations on LV as compared to outdoor path segments.. 172
Table 6.4: More outdoor path segments were used for walking for recreation as compared to indoor path segments 174
Table 6.5: Distribution of path segments by length.. 174
Table 6.6: A higher percentage of long path segments were used for recreational walking as compared to short path segments... 176
Table 6.7: Distribution of path segments by location inside buildings.......................... 177
Table 6.8: Relationship between location of indoor path segments and path use for recreation.. 179
Table 6.9: All other types of outdoor segments were used more for getting to destinations as compared to path segments/trails through nature. 181
Table 6.10: Fewer paths/trails through landscaped areas were used for recreational walking as compared to all other types of outdoor path segments 182
Table 6.11: More outdoor bitumen path segments were used as compared to other types of outdoor path segments. 184
Table 6.12: More moderately sloping or steep path segments were used for recreational walking as compared to flat path segments. 186
Table 6.13: More path segments without steps were used for recreational walking as compared to path segments with steps... 188
Table 6.14: More path segments with amenities were used for getting to destinations . 191
Table 6.15: More path segments without amenities were used for walking for recreation 191
Table 6.16: More path segments with residential destinations were used for walking to destinations 194
Table 6.17: More path segments with activity related destinations along them were used for walking to destinations on LV. 195
Table 6.18: More path segments with administration related destinations along them are used for walking to destination on LV... 196
Table 6.19: Relationship between path use for recreation and presence of residential destination along segment... 197
Table 6.20: More path segments with parking destinations were used for recreational walking at LV 198
Table 6.21: More path segments from which many different types of views could be obtained were used for recreational walking 201
Table 6.22: Path segments with views to public spaces were used more for walking to destinations 204
Table 6.23: More path segments with views to artwork were used for getting to destinations 205
Table 6.24: More path segments with views to residential areas were used for recreational walking.. 206
Table 6.25: More path segments with views to tended nature were used for recreational walking.. 207
Table 6.26: More path segments with views to tended nature were used for recreational walking.. 208

Table 6.28: Path segments that were part of more routes on campus were used more for walking to destinations ... 212
Table 6.29: More path segments that were part of many routes on campus were used for recreation... 213
Table 6.30: Number of residents in different categories who used different recreational routes for walking ... 222
Table 6.31: Path characteristics that are related to path use for walking for recreation or for getting to destinations on the LV campus. ... 231

CHAPTER 7

Table 7.1: Characteristics of PV survey respondents ... 235
Table 7.2: Path use for walking overall and among different categories of residents ... 239
Table 7.3: More indoor path segments were used for getting to destinations on LV as compared to outdoor path segments ... 242
Table 7.4: More outdoor path segments were used for walking for recreation as compared to indoor path segments ... 243
Table 7.5: Distribution of path segments on PV campus by length... 243
Table 7.6: More long path segments were used for recreational walking as compared to short path segments... 245
Table 7.7: Distribution of path segments by location inside buildings... 246
Table 7.8: More indoor path segments between resident apartments and connections between buildings were used for recreational walking as compared to other types of indoor path segments ... 248
Table 7.9: Types of outdoor path segments on PV campus... 248
Table 7.10: More sidewalk segments were used for walking to destinations as compared to other types of outdoor path segments ... 249
Table 7.11: More sidewalks segments were used for recreational walking as compared to other types of outdoor path segments. ... 250
Table 7.12: A higher percentage of moderately sloping and steep segments were used for recreation as compared to flat segments. ... 253
Table 7.13: More outdoor path segments with street crossings in them were used for recreational walking as compared to outdoor path segments without street crossings... 255
Table 7.14: More path segments without steps are used for recreational walking as compared to path segments with steps. ... 256
Table 7.15: A higher percentage of direct path segment were used as compared to disjointed path segments ... 258
Table 7.16: More path segments with residences along them were used for walking to destinations on PV. ... 260
Table 7.17: More path segments with residences along them were used for recreational walking... 261
Table 7.18: More path segments from which many different types of views could be obtained were used for recreational walking ... 265
Table 7.19: Number of path segments with different types of views ... 266

Table 7.20: More path segments with views to residential areas were used for recreational walking.......... 268
Table 7.21: More path segments with views to tended nature were used for recreational walking.......... 269
Table 7.22: More path segments with views to tended nature were used for recreational walking.......... 270
Table 7.23: More central path segments were used for walking to destinations at PV .. 272
Table 7.24: Shallower path segments were used for walking for recreation at PV........ 273
Table 7.25: Path segments that were part of more routes on campus were used more for walking to destinations 275
Table 7.26: More path segments that were part of many routes on campus were used for recreation.......... 276
Table 7.27: Number of residents using different types of routes at PV.......... 284
Table 7.28: Results summary from analysis of local, relational and global path characteristics.......... 292

CHAPTER 8

Table 8.1: Path characteristics that are related to path use for walking to destinations in the three communities.......... 299
Table 8.2: Path characteristics that are related to path use for walking for recreation at the three communities.......... 303

APPENDIX B

Table B.1: Path segment use for walking to destinations at PS.......... 385
Table B.2: Path segment use for walking for recreation at PS 385
Table B.3: Path segment use for walking to destinations at LV.......... 386
Table B.4: Path segment use for recreational walking at LV 387
Table B.5: Path segment use for walking to destinations at PV 388
Table B.6: Path segment use for walking for recreation at PV.......... 388

LIST OF FIGURES

Page Number

CHAPTER 2

Figure 2.1: Ecological framework used in this study 13
Figure 2.2: Figure showing the relationship between environmental press and competence (Lawton, 1982).. 15
Figure 2.3: Behavioral model of the environment, (Moudon & Lee,2003)...................... 20

CHAPTER 3

Figure 3.1: Definition of path segment used in this study 32
Figure 3.2: Plan of PS showing how line segments are drawn using the GIS software. Indoor path segments are shown in blue and outdoor path segments in red. 53

CHAPTER 4

Figure 4.1: Campus plan of PS with adjacent state park golf course shown 61
Figure 4.2: Plan of the main Clubhouse floor and Villa building 1000, 2000 and 3000.. 62
Figure 4.3a: Gazebo in the landscaped courtyard between Villa buildings 2000 and 3000 (left)... 63
Figure 4.3b: View of the lake from the path segment bordering it (right)........................ 63
Figure 4.4: Campus plan of LV showing the East and West Village building................. 67
Figure 4.5: plan of 4th floor of the West Village and the main floor of the clubhouse..... 68
Figure 4.6a: Path leading to the front entrance of the clubhouse from the parking lot (left) 69
Figure 4.6b: Connections between the West Village and the Clubhouse (right).............. 69
Figure 4.7a: View into the swimming pool at the lower clubhouse level (left)................ 69
Figure 4.7b: View into the exercise room from the corridor at the lower clubhouse level (right) 69
Figure 4.9: Campus plan of PV showing the resident apartment building (RSC), the nursing building, Village Center and Cottages. 73
Figure 4.10a: Indoor connection between RSC and HSC on the second floor (left)........ 74
Figure 4.10b: View of the lake and Village Center from the covered connection between the RSC and the HSC.. 74
Figure 4.12: Buildings plans of the first floor of the RSC building (left) and main floor of the Village Center (right) 75

CHAPTER 5

Figure 5.1: Path segments that were used (in red) and not used (in blue) for walking to destination at PS 85
Figure 5.2: Path segments that were used (in red) and those that were not used (blue) for recreational walking at PS 86
Figure 5.3: Outdoor (red) and indoor (blue) path segments on the PS campus........ 90
Figure 5.4: Long (in red) and short (in blue) path segments on the PS campus........ 94
Figure 5.5: Fourteen percent of all path segments at PS have steps in them (red)........ 105
Figure 5.6: PS site plan with overlay of path segments that are disjointed (red) and continuous (blue) 108
Figure 5.7: PS site plan with overlay of path segments with amenities (red), no amenities (blue)........ 111
Figure 5.8: PS site plan with overlay of path segments with residential destinations (red) 113
Figure 5.9: PS site plan with overlay of path segments with activity related destinations (red)........ 113
Figure 5.10: PS site plan with overlay of path segments with parking destinations along them (red)........ 113
Figure 5.11: PS site plan with overlay of path segments with natural destination on them (red)........ 114
Figure 5.12: PS site plan with overlay of path segments with one or more destinations along them (red) and no destinations (blue) 119
Figure 5.13: Path segments at PS with many views (red) and few views (blue)........ 122
Figure 5.14: PS site plan with overlay of path segments with residential views (red)... 125
Figure 5.15: PS site plan with overlay of path segments with views of water (red) 127
Figure 5.16: PS site plan with overlay of path segments with views to artwork........ 131
Figure 5.17: PS site plan with overlay of path segments showing a gradient of mean depth values 133
Figure 5.18: PS site plan with overlay of path segments that are less central (blue) and more central (red) within the campus path network 134
Figure 5.19: High choice (red) and low choice (blue) path segments at PS........ 137
Figure 5.20: Path segments in red are used most for recreation on the PS campus........ 140
Figure 5.21: Path segments in red are used most my male residents........ 141
Figure 5.22 : Path segments in red are used most by female residents........ 141
Figure 5.23: Path segments in red were used most by residents using assistive devices 142
Figure 5.24: Path segments in red were used most by residents not using any assistive devices........ 142
Figure 5.25: Path segments in red were used highly by residents reporting any health problems........ 143
Figure 5.26: Path segments in red were used highly by residents not reporting health problems........ 143
Figure 5.27: Path segments in red were used most by resident aged 72 or less 144
Figure 5.28: Path segments in red were used most by residents between 73 and 80...... 145
Figure 5.29: Path segments in red were used most by residents aged 81 or over........ 145
Figure 5.30: Path segments in red were used most by insufficiently active residents.... 146
Figure 5.31: Path segments in red were used most by sufficiently active residents....... 146

Figure 5.32: Path segments in red were used most by highly active residents. 146
Figure 5.33: Path segments in red were used most by cottage residents 147
Figure 5.34: Path segments in red were used most by apartment residents.................... 147
Figure 5.35: The most highly used outdoor routes on the PS campus............................ 148
Figure 5.36: View of lake and cottages from path segments around the lake at PS....... 150
Figure 5.37: View of road leading to gatehouse of PS campus 151
Figure 5.38: Mailboxes on sidewalk in front of cottages at PS 152
Figure 5.39: Gazebo in landscaped courtyard between building 2000 and 3000 153
Figure 5.40: The 20 path segments at PS that were used most for walking to destinations (in red).. 155

CHAPTER 6

Figure 6.1: Path segments in red were used for walking to destinations on LV............. 167
Figure 6.2: Path segments in red were used for walking for recreation on the LV campus 168
Figure 6.3: Path segments in blue are indoor path segments within buildings and path segments in red are outdoor path segments 171
Figure 6.4: Sixty percent of the longer path segments (in red) are located outside buildings on the LV campus 175
Figure 6.5: The nature path segments/trails (red) are mostly located in the landscaped area to the north of the residential buildings and clubhouse.............................. 180
Figure 6.6: Distribution of path segments on campus based on gradient – flat or gentle slope (red), moderate slope (pink), steep slope (blue)....................................... 185
Figure 6.7: Most of the path segments on campus with amenities (red) are located indoors 190
Figure 6.8: Path segments in red have residential destinations along them.................... 192
Figure 6.9: Path segments in red have activity related destinations along them 193
Figure 6.10: Path segments with parking destinations along them (red)........................ 193
Figure 6.11: Path segments with one or more destinations along them (red) and no destinations (blue) at LV.. 198
Figure 6.12: Path segments with many views (red) and path segments with few views (blue).. 200
Figure 6.13: Path segments in red have views to residential areas................................ 202
Figure 6.14: Path segments in red have views to landscaped nature 203
Figure 6.15: Path segments on campus range from closer to all other path segments (red) to deeper from all other path segments (blue) 209
Figure 6.16: High choice (red) and low choice (blue) path segments on the PS campus. 211
Figure 6.17: The 20 path segments on campus that were used most for walking for recreation when all categories of residents were considered 214
Figure 6.18: Twenty path segments used most for recreation by male residents at LV (in red) 215
Figure 6.19: Twenty path segments used most for recreation by female residents at LV (in red)... 215

Figure 6.20: Twenty path segments used most for recreation by residents using assistive devices.. 216
Figure 6.21: Twenty path segments used most for recreation by residents not using any assistive devices 216
Figure 6.22: Twenty path segments most used for recreation by residents reporting health problems (in red)... 217
Figure 6.23: Twenty path segments used most for recreation by residents reporting no health problems.. 217
Figure 6.24: Twenty path segments used most for recreation by residents aged 72 years or less (in red)... 218
Figure 6.25: Twenty path segments used most for recreation by residents aged between 73 and 80 years (in red) 218
Figure 6.26: Twenty path segments used most for recreation by residents aged 81 and over 218
Figure 6.27: Twenty path segments used most for recreation by insufficiently active residents 219
Figure 6.28: Twenty path segments used most for recreation by sufficiently active residents 219
Figure 6.29: Twenty path segments used most for recreation by highly active residents 219
Figure 6.30: Twenty path segments most used for recreation by apartment residents (in red)... 220
Figure 6.31: Twenty path segments most used for recreation by cottage residents (in red) 220
Figure 6.32: Highly used outdoor recreation routes at LV 222

CHAPTER 7

Figure 7.1: Path segments that were used (red) and not used (blue) for walking to destinations at PV 237
Figure 7.2: Path segments in red were used most by PV residents for walking to destinations 237
Figure 7.3: Path segments in red were used for walking for recreation PV 238
Figure 7.4: Indoor (blue) and outdoor (red) path segments on the PV campus............. 241
Figure 7.5: Short (blue) and long (red) path segments at PV 244
Figure 7.6: Path segments in red are moderately sloping or steep path segments, path segments in blue are flat segments.. 252
Figure 7.7: Path segments in blue are disjointed path segments on the PV campus 257
Figure 7.8: Path segments with one or more destinations (red) and no destinations (blue) along them.. 263
Figure 7.9: Path segments with many views (red) and few views (blue) 264
Figure 7.10: Path segments with views to residences (red)... 266
Figure 7.11: Path segments in red have views to landscaped nature 266
Figure 7.12: A gradient from most central (red) to least central (blue) path segments on the PV campus 271
Figure 7.13: High choice (red) and low choice (blue) path segments at PV 274

Figure 7.14: Path segments in red are used most for recreational walking at PV 277
Figure 7.15: Path segments in red were used most by male residents for recreational walking.. 278
Figure 7.16: Path segments in red were used most by female residents for recreational walking.. 278
Figure 7.17: Path segments in red were used most by residents using assistive devices 279
Figure 7.18: Path segments in red were used most by residents not using any assistive devices.. 279
Figure 7.19: Path segments in red were used most for recreation by residents aged below 72.. 279
Figure 7.20: Path segments in red were used most for recreation by residents aged 73 to 80.. 280
Figure 7.21: Path segments in red were used for recreation by residents aged 81 and over 281
Figure 7.22: Path segments in red are used most by insufficiently active residents....... 281
Figure 7.23: Path segments in red are used most by sufficiently active residents.......... 282
Figure 7.24: Path segments in red are used most by highly active residents.................. 282
Figure 7.25: Path segments in red were used most for recreation by cottage residents . 283
Figure 7.26: Path segments in red were used most for recreation by apartment residents 283
Figure 7.27: Highly used recreation routes at PV.. 285

CHAPTER 8

Figure 8.1: Recreational routes on the PS campus 314
Figure 8.2: Recreational walking routes on the LV campus... 314
Figure 8.3: Recreational walking routes on the PV campus... 314

SUMMARY

The aim of this thesis was to identify the characteristics of path segments and routes that are associated with where older residents choose to walk for recreation or for getting to destinations in retirement communities. The goal was to use the findings from this study to help formulate criteria and strategic choices that can be used to design retirement communities that support walking among elderly residents. This thesis asks what aspects of campus path design may be related to where older residents choose to walk.

Case studies were conducted at three Continuing Care Retirement Communities to study the relationship between physical design characteristics of path segments and their use for walking to destinations or for recreation. The study shows that route choice for walking to destinations is shaped by practical considerations of distance and convenience and largely determined by the relative location of destination and origin. On the other hand, route choice for recreational walking is more complex and is determined by local, relational and structural environmental characteristics of the path segments that comprise the routes as well as characteristics of the residents themselves. Residents chose routes of different difficulty level for walking based on their physical abilities and health. This study also found that many residents chose to walk indoors for recreation, especially along corridors between resident apartments. Understanding how different factors together shape route choice leads to the clarification of design alternatives. This study suggests that designing campuses to support walking involves not only a careful consideration of individual local path segment characteristics but also an understanding of how path segments and routes fit within the larger network of path segments on campus. Further, it is important to design routes with a range of characteristics and a range of challenge so that residents have many options to choose from and they have the option to move from a lower level of challenge to a higher one when they feel ready.

CHAPTER 1

INTRODUCTION

This thesis deals with the physical environmental characteristics of paths in retirement community campuses that are associated with where older adults walk. The aim is to understand how the local, relational and global properties of walking paths in retirement campuses are associated with where older adults walk for recreation or to get to a destination. The goal is to use the findings from this study to help formulate criteria and strategic choices that can be used to design retirement communities that support walking among elderly residents.

Growing evidence from many different fields suggests that the environment plays an important role in shaping physical activity behavior of all individuals including older adults. However, most of the research to date is focused on neighborhood scale issues (Giles-Corti et al., 2005; W. C. King et al., 2003; Powell, 2005; Saelens, 2003). Little is known about the relationship between building and site level factors on active living among older adults (Zimring, Joseph, Nicoll, & Tsepas, 2005).

This is a critical gap when one considers the fact that many older adults spend a large part of their time in and around buildings. By understanding how older adults use their environment for physical activity we would be able to better design these settings to support these activities. For example, if we knew the types of paths and the characteristics of paths that older adults are likely to choose to walk for recreation or to get somewhere, then environments for older adults could be designed to maximize physical activity opportunities. This thesis seeks to fill a critical gap in the knowledge that informs the design of activity friendly residential environments for older adults.

Activity friendly environments for older adults

Regular physical activity contributes to better health even among old and very old individuals (Shephard, 1997). The benefits of physical activity for older people include prevention and treatment of chronic illnesses, a longer disability free life expectancy and better physiological and psychological health (Miller, 2000; Leveille, 1999; Shephard, 1997, USDHHS, 1996). Despite the well-established benefits of physical activity for older adults, the segment of the American population aged 50 years and above is the most inactive, with inactivity being particularly pervasive among the age group 75 and older (USDHHS, 1996). To address the problem of inactivity among Americans, public health and policy researchers have expanded their focus from individual level approaches to environmental approaches that have the potential to influence a community as a whole (RWJF, 2000. p. 28). However, while there is an increasing body of evidence about environmental barriers and enablers of physical activity among older adults at the neighborhood and community scale, little is known about the role of buildings and sites in promoting physical activity (Joseph & Kiefer, 2004; Zimring et al., 2005).

Walking is the most popular physical activity among older adults (Feskanich, Willett, & Colditz, 2002; Tudor-Locke, Jones, Myers, Paterson, & Ecclestone, 2002). People walk for two main reasons – either to get somewhere or for exercise/recreation. The former is termed instrumental walking and the latter recreational walking. A limited number of studies have specifically explored the environmental determinants of walking among older adults living in traditional neighborhood settings. Factors such as perceived aesthetics of the neighborhood (Brownson et al., 2000), perceived safety of walking paths in the neighborhood (Booth, Owen, Bauman, Clavisi, & Leslie, 2000) and convenient location and access to recreational facilities and shops (Booth et al., 2000; R. Brownson et al., 2000; Carnegie, 2002, King et. al, 2003) were found to be associated with *higher levels of walking* among older adults.

Only one study to date has looked at how building and site features influences *participation in physical activity* such as walking among older adults (Joseph, Zimring, Harris-Kojetin, & Kiefer, 2005). This study, a survey of 800 not-for-profit continuing care retirement communities (CCRC), looks at the relationship between building and site levels features on CCRC campuses and participation in different types of physical activity among residents. The findings from this study suggest that communities with more indoor and outdoor physical activity facilities and amenities tend to have more residents participating in physical activity (Joseph et al., 2005). Modest but significant associations were found between the presence of outdoor features such as courtyard gardens and covered outdoor paths and resident participation in walking clubs (Joseph et al., 2005). Also, more independent living residents walked to meals on campuses that had covered connections between buildings. Due to the limitations of the survey technique, specific building and site features (such as location of paths, length of paths, etc.) that may be related to physical activity behavior such as walking could not be explored. Also, it was not possible to determine where exactly in the community the residents walked or why they chose to walk there. The authors suggest detailed case studies and interviews and focus groups with residents as the next step to obtaining a deeper understanding of the relationship between building and site features and participation in physical activity such as walking (Joseph et al., 2005).

The studies described above suggest that people may choose to participate in physical activity such as walking or may choose to walk more (or less) in environments that possess (or are lacking in) certain resources and general attributes such as safety, convenience and attractiveness. Researchers are beginning to identify what these attributes really mean in terms of design characteristics of urban and residential environments that support walking (Pikora et al., 2002; Boarnet, Day, Alfonzo, Forsyth, & Oakes, 2006 (forthcoming); Day, Boarnet, Alfonzo, & Forsyth, 2006 (forthcoming)). The assumption is that people will walk more in environments that possess certain environmental characteristics. However, these studies have assessed the relationship between environmental characteristics and walking among a general population and in traditional neighborhood settings. In the absence of existing studies looking at walking behavior of older adults in campus settings, it is difficult to make any statements about how certain environmental characteristics may be related to more or less walking on residential campuses for older adults. First, it is important to understand the types of choices older adults make while walking in such settings and how their choices for walking may be shaped by environmental factors.

I

To address this question, it becomes important to understand if some spaces are more supportive than others and are thus chosen more often for walking. The question then is: what environmental characteristics of highly used spaces make them particularly amenable for walking among older adults? None of the studies to date answer that question because they have not specifically examined where older adults walk. This is an important question to answer - not only from the standpoint of advancing our understanding of walking behavior among older adults in campus settings, but also from the standpoint of a designer, developer or manager of retirement communities. In order to create activity friendly areas for walking within their community, they need to know which types of paths are likely to be used more often for walking and how they may make those paths more supportive for walking among older adults.

The existing literature suggests that the physical environment of buildings and sites is associated with walking patterns in terms of certain qualities of the route along which people walk as well as certain aspects of the overall spatial configuration of the setting (which cannot be directly perceived by its inhabitants) (Haq & Zimring, 2003; Peponis & Wineman, 2002). The former characteristics of the environment may be termed *local* or *relational* and the latter qualities *global or structural. Local* path characteristics occur in a specific path or path segment, such as paving quality, availability of seating, presence of steps or other barriers, lighting, protection from the elements, aesthetic quality and ability to get help when needed. *Relational* qualities are those that reflect visibility of pathways and features, such as whether attractive views of nature can be seen by residents as they go about their daily business. *Global* characteristics of paths are characteristics that paths possess as a result of their position within the larger structure or network of paths to which they belong (Zimring et al., 2005) . This framework is similar to that proposed by other theorists such as Moudon and Lee (2003), who suggested that at the urban scale origins and destinations, route characteristics and area characteristics are together related to walking behavior. However, these have not been explored at the site and building scales.

This thesis aims to study how certain local, relational and global characteristics of paths may be associated with where older residents choose to walk in retirement communities. By focusing on where people walk, the study identifies the characteristics of paths that support walking choices among older residents.

Though the physical context of the environment is a prerequisite for walking, it is clear that there are other factors as well are related to walking among older adults. Personal, social and organizational factors are associated with participation in physical activity among older adults along with environmental factors (King, Rejeski, & Buchner, 1998). A social ecological model that conjectures the relationship between different factors such as interpersonal, social/cultural, organizational and physical environment and assumes that these variables interact to influence behavior is appropriate for the current study. Thus, while the focus of this study is on how environmental factors may be associated with where people walk in retirement communities, it is likely that certain personal and organizational factors may also be associated with their choice and this is taken into consideration within this framework.

Case studies were conducted at three Continuing Care Retirement Communities (CCRC) located in the Atlanta, Georgia area. CCRCs are a specific type of retirement community that supply a continuum of care (skilled nursing care, assisted living and independent living) throughout the lifetime of elderly residents. They usually offer a range of housing, services and health care that is centrally planned and administered. Most CCRCs are typically comprised of different buildings housing different functions (residential, administrative, recreational, religious, etc) and are connected through a network of paths and roads within a defined boundary. This unique, almost self-sufficient, village-like quality of these communities makes them particularly interesting to study. There are an estimated 2,600 CCRCs in the United States and more than 660,000 Americans live in CCRCs (AAHSA, 2005). Nearly 13% of the American population is aged 65 and older and this is expected to increase to approximately 20% by 2030 (Shi & Singh, 2001). Given this demographic trend, the need for these types of communities is only likely to increase in the coming years. It is critical to understand how we may design such communities to promote active aging.

CHAPTER 2

ACTIVITY FRIENDLY ENVIRONMENTS FOR OLDER ADULTS

Physical activity is extremely beneficial for older adults and there is significant potential to promote walking among older adults. Older adults walk to either get to or from somewhere or for recreation or exercise. Physical activity behavior among older adults is a complex phenomenon and there are many factors that either inhibit or support physical activity such as walking. An activity-friendly environment has been identified as a critical component in the broad matrix of factors that are related to participation in physical activity such as walking.

There is an increasing focus by public health professionals on the role played by the environment in supporting healthy behaviors such as walking. One of the strategies identified in the National Blueprint on Physical Activity Among Adults Age 50 and Older to enhance health and increase physical activity is '*to create, promote and sustain communities that support lifelong physical activity*' (RWJF, 2000. p. 28). An important component of this effort involves innovations through design of the physical environment to support and sustain habitual physical activity. The extent to which older people are active depends on their health and physical abilities, lifestyle as well as opportunities afforded to them in their homes, communities and places of work. However, there is little research to date that looks at the relationship between the environment and physical activity in the context of older people. This chapter reviews the literature examining these relationships between the physical environment and walking among older adults.

The chapter focuses on three main themes: 1) the importance of walking for older adults 2) the components of an activity friendly environment and 3) the role of the environment.

2.1. The importance of walking for older adults

Physical activity is beneficial for older adults

According to the report on 'Physical Activity and Health' (USDHHS, 1996) – '*Regular physical activity reduces the risk of dying prematurely, developing diabetes, developing high blood pressure, and developing colon cancer. It reduces feelings of depression and anxiety, helps control weight, helps maintain healthy bones and muscles and promotes psychological well-being*.'

Regular physical activity plays a critical role in the prevention and treatment of chronic diseases in older adults. According to Shephard (1997), regular physical activity can delay the time when functional capacity declines to the critical threshold for a loss of independence. Thus a physically active person is likely to remain independent for a longer period of time as compared to an inactive person though they may live for the same number of years. Physically active adults are more likely to survive to age 80 or beyond and have approximately one-half the risk of dying with disability compared to sedentary peers (Leveille, 1999). Miller and colleagues (Miller, 2000) reported results from 5151 participants in the Longitudinal Study of Aging. They showed that older adults who walked a mile at least once a week were significantly less likely to progress to functional limitations or disability than their sedentary counterparts over the 6 years of follow up. A 12-year longitudinal study of 12,600 postmenopausal women found that moderate levels of activity, including walking, are associated with substantially lower risk of hip fracture (Feskanich et al., 2002). In addition to physiological benefits such as improved cardiovascular endurance, improved balance and flexibility, physical activity can also have significant psychological consequences (A. C. King et al., 1998). Regular participation in physical activity reduces stress and anxiety, enhances mood and general well-being, improves mental health and may help postpone age related cognitive decline .

Nearly 13% of the American population is aged 65 and older and this is expected to increase to approximately 20% by 2030 (Shi & Singh, 2001). The ‘old-old’ age group is growing particularly quickly - the over-85 group is most rapidly growing sector of the US population and it is estimated that over eight million Americans will be 85 years of age or older by 2030 (Shi & Singh, 2001). It is estimated that by delaying the onset of disability, an increase in physical activity levels among older adults will reduce the costs of geriatric institutional care by almost 30% (Shi & Singh, 2001).

Walking is the most popular physical activity among older adults

Walking is the most popular physical activity, both for exercise and as an activity performed during the course of daily activities (Feskanich et al., 2002; Hamdorf, Starr, & Williams, 2002; Henderson & Ainsworth, 2000; Tudor-Locke et al., 2002). Walking can be done anywhere and does not need any equipment (Henderson & Ainsworth, 2000). Further, it can be done alone or with others and can give health benefits without the commitment required for an exercise regimen. Constraints to walking include bad weather, poor or no sidewalks and lack of perceived safety (Henderson & Ainsworth, 2000).

How much should older adults walk?

The recommendation on physical activity indicates that all individuals should participate in moderate intensity physical activity (such as walking) for at least 30 minutes a day, on most days of the week. Moderate intensity physical activity is defined as activity performed at an intensity of 3 to 6 METs (work metabolic rate/ resting metabolic rate) – the equivalent of walking at 3 to 4 mph for most healthy adults (Pate, 1995). They also suggest that physical activity benefits can be accrued in small bouts (minimum 10 minutes) over the course of the day rather than in a single dedicated exercise session (Pate, 1995). This recommendation emphasizes the fact that regular household, occupational and leisure activities complement exercise sessions and contribute to the daily accrual of physical activity. This is extremely significant for older adults because many older adults may not participate in structured vigorous activities but may participate in moderate intensity physical activity such as walking regularly on their own (Brownson, Eyler, King, Brown, & al, 2000).

Why do people walk?

People walk for leisure or for the specific purpose of getting to a destination. Three main categories of physical activity can be defined based on the intention of the individual (Zimring et al., 2005).

Recreational Physical Activity is aimed at pleasure, diversion, exercise, improving health and functioning; it can be individually or facility-organized such as would be found in exercise rooms or outdoor exercise areas. ***Instrumental Physical Activity*** is the byproduct of engaging in an activity in which recreation or physical activity was not the purpose of the action. Instrumental physical activities may be the result of routine or utilitarian activities such as walking to or from transit or home or housework like laundry or situational activities such as household repair. ***Hybrid Physical Activity*** results when health or physical activity may not be the primary goal though the individual may make a decision to be physically active while working toward that goal, such as choosing to use the stairs instead of the elevator (Zimring et al., 2005). The distinction between instrumental activities and hybrid activities is a subtle but important one. For example, in a multi-story building with no elevators, climbing stairs is the only option – it is an instrumental activity. However, when the individual decides to takes stairs even when elevators or escalators are present in the building he/she is consciously choosing to do so for any number of reasons –because it is a faster route, it is more attractive, etc. Here stair-climbing is neither instrumental nor purely recreational, but a hybrid of the two.

2.2 Components of an activity friendly environment: where do people walk?

Where do people walk?

The physical activity and public health literature is primarily concerned with physical activity participation – for example, whether people are walking and how often they are walking. The goal is usually to get more people to walk (or participate in other physical activities) or to get people to walk more often using a variety of strategies. Understanding the relationship between design and the choice to participate in physical activity is an important public health issue. However, in order to design and plan environments that are supportive of walking it is also important to understand where people choose to walk. Since there are few studies focusing on where people walk, findings from studies assessing both types of outcomes (walking levels/participation and where people walk) are reviewed, since environmental factors that that are related to the *decision to walk* may plausibly be related to *where* people choose to walk.

Participation in physical activity by older adults is influenced by several factors including *personal factors, social/cultural, organizational* and *environmental factors* (King, 2001). While these factors have been shown to influence participation in physical activity such as walking, they are also likely to be related to path choice for walking. *Personal* factors are characteristics of the individual such as age, functioning, health, attitude that influence an individual's decision to walk/physical activity levels (King, 2000) as well as where he chooses to walk (Lawton, 1982; Patla & Shumway-Cook, 1999; Shumway-Cook, et al., 2003). *Organizational* policy and attitudes towards physical activity influences types of programs available, costs, staffing and staff attitudes and allotment of funds for promotion of physical activity in a facility such as a CCRC (Harris-Kojetin, Kiefer, Joseph, & Zimring, 2005). Organizational rules and policy may also determine which spaces are available for walking for residents in a residential facility. Membership in a walking club, having pets and company are *social* factors that support walking. Also, people may choose routes for walking where they are likely to meet other people. *Environmental* factors are aspects of the physical environment that support or act as constraints to walking. This study focuses on the aspects of the environment that may be related to path choice for walking among older adults.

Where people choose to walk depends on the above factors but also on the purpose of the trip. That is people are likely to choose environments with different characteristics for walking based on whether their goal is instrumental or recreational. A study which examined the relationship between characteristics of the neighborhood environment and walking for different purposes (general walking, walking for pleasure, walking for exercise and walking to get to and from places) among adults over 40 found that different factors were associated with different types of walking behavior (Humpel, Owen, Iverson, Leslie, & Bauman, 2004). For example, men were significantly more likely to walk for exercise in their neighborhoods if they perceived weather as not inhibiting their walking. For women, neighborhood walking was associated with ratings of 'convenience' while walking for pleasure was associated with moderate perceptions of 'accessibility' (Humpel et al., 2004). This research suggests that different types of environments may be chosen for walking based on the whether the individual is walking to get to a destination or is walking for recreation or exercise.

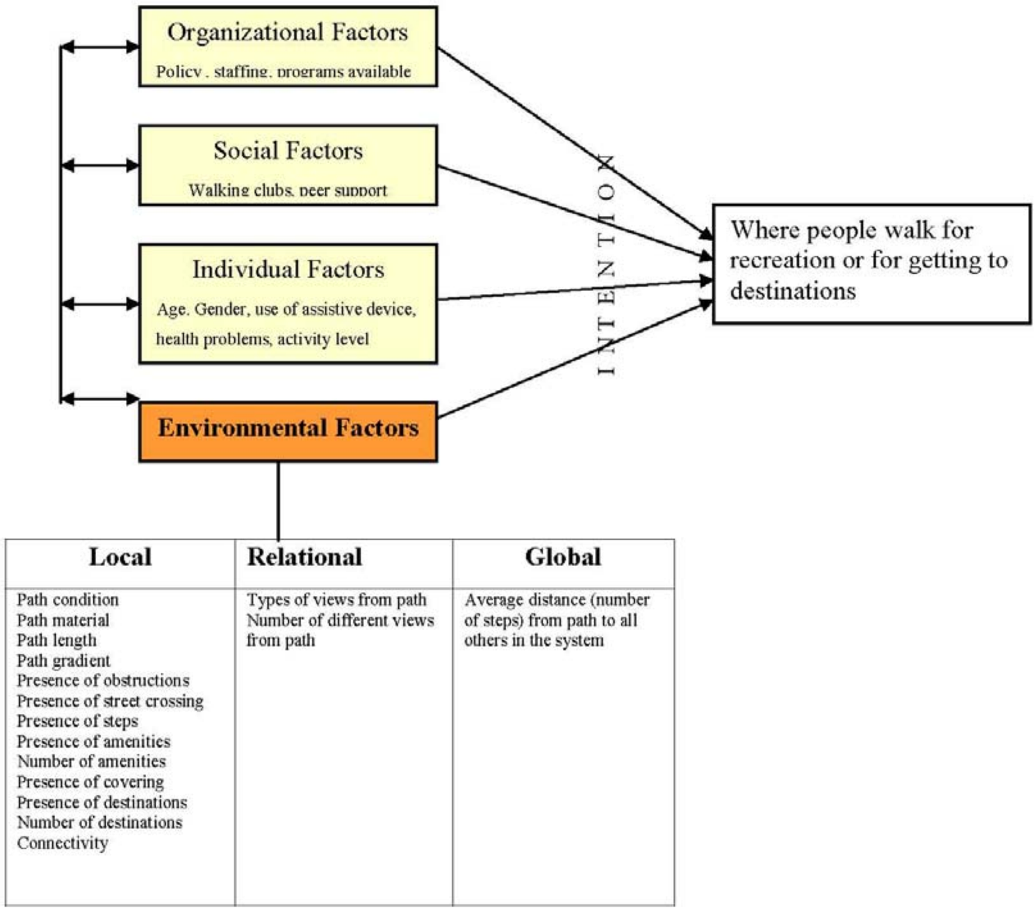


Figure 2.1: Ecological framework used in this study

A social ecological model that conjectures the relationship between different variables such as interpersonal, social/cultural, organizational and physical environment and assumes that these variables interact to influence behavior is ideal for the current study. Ecological Models are comprehensive health promotion models that are multifaceted, concerned with environmental change, behavior, and policy that help individuals make healthy choices in their daily lives. The philosophical underpinning is the concept that behavior does not occur within a vacuum. Social ecological models have their roots in public health and psychology (Barker, 1968; Bronfenbrenner, 1992; Stokols, 1987; Stokols, Grzywacz, McMahan, & Phillips, 2003).

Ecological Models address multiple levels of behavior influence, leading to a more comprehensive approach to health promotion (Satariano & McAuley, 2003). As described earlier, though the physical context of the environment is a prerequisite for walking, it is clear that there are other factors as well that are related to where older adults choose to walk.

Personal Factors: include demographic and health variables, an individual's knowledge, attitudes and beliefs related to physical activity and psychological or behavioral attributes and skills that may facilitate or impede efforts to participate in physical activity (King, 2001). Other personal factors that influence participation in physical activity include level of functioning, gender, occupational status and age. Higher functioning residents are more likely to participate in both facility and community based resident-initiated activities (Lemke, 1989). Women and those with higher educational and occupational status also show higher involvement in independent activities (Lemke and Moos, 1989). Younger residents are more likely to participate in community activities. In a survey of cognitively intact subjects aged 90 and older it was found that age was negatively related to physical activity levels (Hilleras, Jorm, Herlitz, & Winblad, 1999). Fears of injury and medical concerns (Shephard, 1997) act as barriers to physical activity. Perceived lack of ability and misconceptions about exercise were also personal factors that influenced participation in physical activity.

While personal factors are clearly related to how active an individual chooses to be, other studies have shown that personal factors may also be related to *where* an individual chooses to be while participating in physical activity such as walking. An important factor that is linked to where older adults choose to walk is the mobility of the individual. A study by Shumway-Cook and colleagues (2003) shows that older adults with mobility disability (use walker, canes or other assistive devices for walking) reported fewer encounters with and concomitantly greater avoidance of physical challenges such as stairs, long distance or stimulating environments than non-disabled older adults.

According to Patla and Shumway Cook (1999, pp. 11-12), "*Mobility in a wide range of environments requires individuals to adapt how they sense and how they move. If individuals cannot adapt appropriately to changes in environmental contexts, they could choose to avoid moving in those contexts…..If an individual with limited capacity to adapt has to move within challenging environments, the risk for failure (e.g. a fall) will increase.*" Thus, the presence of obstructions and challenges (such as long distances, steps or steep gradients) may result in avoidance of those spaces for walking by some individuals.

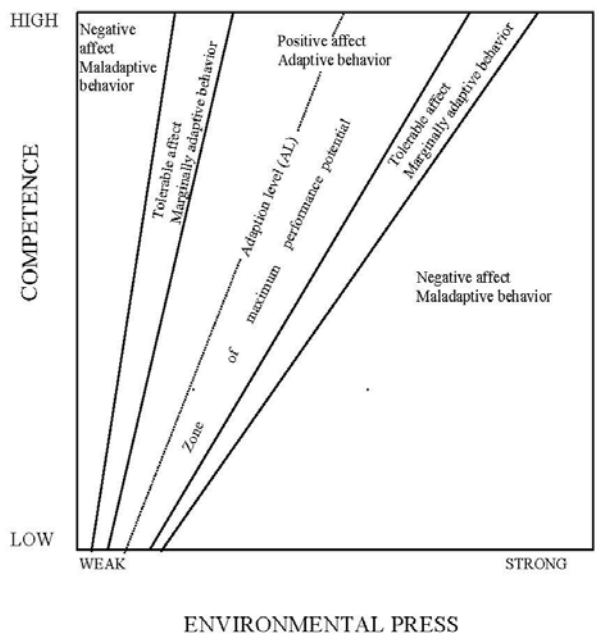


Figure 2.2: Figure showing the relationship between environmental press and competence (Lawton, 1982)

The environmental press-competence theory, developed in the field of environmental psychology, also helps us understand how the characteristics of the physical environment might be related to where an individual chooses to walk. This theory provides a way to understand human behavior as a function of personal characteristics of an individual (competence), and environmental factors (environmental press) (Lawton, 1982). *Competence* is a characteristic of the individual and is shaped by factors such as biological health, physical and perceptual abilities, cognitive capacity and ego strength . *Environmental presses* are stimuli in the individual's personal, social and physical environment that place a demand on the individual and thus affect behavior. According to this theory if the environmental press or demand on the individual greatly exceeds or is much lower than his/her competence then there is maladaptive behavior. If the environmental press is appropriate to the level of competence of the individual, there is adaptive behavior. Individuals with high competence can cope with more environmental demands successfully. However, for individuals with lower competence levels (due to ill health, stress etc), the optimum environmental press will be lower. This theory also suggests that if the press is slightly higher than what the individual is able to cope with, he/she will try to adapt. If the individual adapts successfully, it will result in an increase in competence level which means that he/she will be able to increase his threshold level. It is also importance to note that environments that are low in challenge and stimulation will likely result in boredom and withdrawal among individuals with high competence. For examples, Lemke and Moos (1989) found that independent residents in congregate residential facilities were more active in larger facilities with more resources and more autonomy. However, frail residents participated in activities in smaller facilities, where there was more staff support and more structured programs.

This can easily be related to physical activity behavior, with independent older adults utilizing resources such as walking trails, community fitness centers etc. while frailer residents participate in fewer physical activities in a more restricted environmental setting. This model also suggests certain interesting implications for promoting physical activity. Environments that are designed to provide challenge, e.g. by the presence of hills, stairs in buildings, etc. are likely to elicit positive responses (greater physical activity) from independent older adults. On the other hand, frailer residents may avoid walking in such environments. If the environment is not appropriately challenging, residents will not have the opportunity to respond to higher environmental press they are capable of, and may gradually lose the abilities they might possess. Thus, an environment with a range of press provides options for residents with different abilities to challenge themselves and gradually increase their threshold.

The relationships between environmental challenge (or press) and resultant adaptive behavior as proposed by this theory are very relevant to the current study where the effect of factors such as age and functioning may be related to how older residents respond to environmental challenges for walking. However, it must be noted that though this theory provides a good way for us to understand how individuals may respond to environmental challenge, it does not address as effectively the importance of certain motivators or attractors in the environment that might provide the incentive for individuals to walk to places. For example, the presence of an ice-cream parlor was sufficient motivation for residents using walkers at skilled nursing facility to overcome the barriers imposed by distance and elevators (Parker & Joseph, 2003).

Organizational Factors: Factors such as convenience, scheduling, structure, complexity, intensity, duration as well as financial and psychological costs may determine whether older adults decide to undertake a particular type of physical activity (King, 2001). King refers to these as program or regimen-based factors.

Organizational factors may include goals and philosophy of the organization with regard to physical activity, staffing, as well as structure and nature of the physical activity programs and services offered to residents. Program or regimen based factors then become a part of the organizational factors that relate specifically to the structure and nature of physical activity programs and services offered.

Inconvenient schedules and locations act as a disincentive to physical activity among older people (Richter et al, 1993). King suggests that the types of activities that may be most attractive to older adults *"are moderate in intensity, simple and convenient to engage in, inexpensive, noncompetitive and have a social component"* (King, 2001. p. 38). Within the context of a residential facility such as a retirement community, organizational policies and rules (example: those that govern which spaces are available to residents for walking or that require staff presence to engage in certain types of activities) may also be associated with where people choose to walk (Parker & Joseph, 2003).

<u>Social Factors:</u> Social support for physical activity from family and friends, regular participation of friends and family and company for walking are associated with higher levels of physical activity among older adults (Ball, Bauman, Leslie, & Owen, 2001; Booth et al., 2000). In the context of a residential facility, resident support for physical activity plays an important role in promoting participation in physical activity (Harris-Kojetin et al., 2005). Results of a survey of 800 continuing care retirement communities found that campuses with higher resident support for physical activity had more independent living residents participating in a range of different physical activities on campus (Harris-Kojetin et al., 2005). Participation in social activities such as walking clubs was higher in campuses with courtyard gardens and covered outdoor walking paths (Joseph et al., 2005).

<u>Environmental Factors:</u> The environment is increasingly being recognized as an important factor influencing physical activity and there is a growing body of research that supports this. However, the relationship between building and site level environmental factors and physical activity among older adults is still poorly understood. This study primarily focuses on the relationship between environmental characteristics of paths and where people choose to walk, though the relationship with other factors such as organizational and individual are considered to the extent possible.

2.3 The role of environment

Researchers from different fields such as public health, recreation science and urban planning are providing convergent evidence that the environment at different scales – urban/city, neighborhood as well as site and building scale – influences participation in physical activity (Berrigan & Troiano, 2002; Giles-Corti & Donovan, 2002; Handy, Boarnet, Ewing, & Killingsworth, 2002; Humpel, Owen, & Leslie, 2002; Zimring et al., 2005). This body of research shows that people tend to be more physically active in certain types of environments rather than others. However, these studies do not examine the characteristics of the actual spaces where people perform physical activity. However, it is logical to assume that if environments with certain qualities tend to be ones with where people are more active, then the spaces within those environments that are used often for walking are the ones that possess qualities that promote walking.

In the following section, the available evidence about environmental factors that are related to physical activity is reviewed. As mentioned earlier, for the most part the studies examine how the environment influences how often people walk. This body of research is reviewed along with the studies that specifically assess how the environment affects where people walk. Findings at the neighborhood scale that may also be relevant at the campus scale are included. As mentioned earlier, very little research has been conducted at the building and site scale looking specifically at physical activity outcomes among older adults (Zimring et al., 2005). Thus, the scope of the literature search was broadened to other fields such as environmental psychology, spatial cognition and architecture that have examined behaviors such as participation in activities, movement patterns in space and the role played by buildings in shaping such activities.

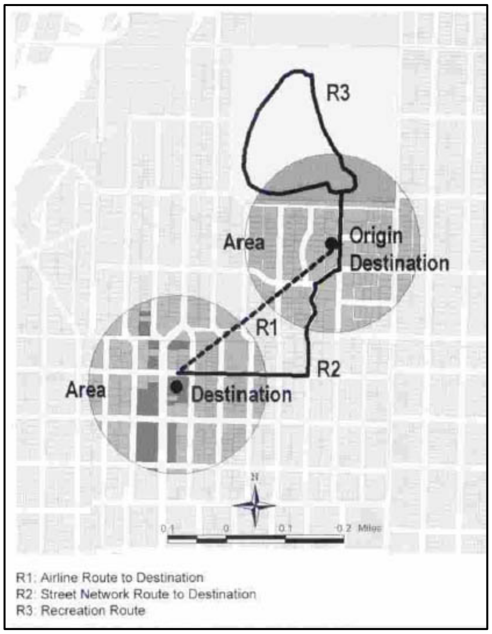


Figure 2.3: Behavioral model of the environment, (Moudon & Lee (2003)

Moudon and Lee (2003) propose a behavioral model of the environment to help define and analyze environmental factors that may be related to whether the design of a community supports walking and cycling for exercise or for getting to destinations. They suggest that the walking environment can be conceptualized in terms of three components: 1) *the origins and destinations* of walking trips – for instrumental walking points of origin and destination tend to be different while for recreational walking they may be the same, 2) the *route* taken during walking trips – these are the specific characteristics of the route such as route length, number of people on route, route quality and 3) *Area* in which the trip takes place – this refers to characteristics of the spaces surrounding routes and origins and destinations that influence route choices (Moudon & Lee, 2003). These three components of the environments are inter-connected and must be considered together for a better understanding of the choices people make while deciding to walk or use other means of transport (Moudon & Lee, 2003).

These three environmental components or spatial units have certain qualities that link them with each other within a system. Thus, paths are connected to other paths either directly or through other paths. Paths are connected to areas and destinations through visual and physical connections. *Global, relational* and *local* are the terms used to refer to those properties of a spatial unit that describe its relationship to other units in its immediate locality (local or relational), or to its entire system (global). The basis for this organization arises from the Space Syntax research program that studies how the configuration of the space in a building, complex, or settlement may systematically relate to patterns of behavior (particularly movement) within it (Peponis & Wineman, 2002; Bafna, 2003). The space in the given building or settlement is typically treated in space syntax as a network of connected but discrete spatial units. Research in space syntax has drawn attention to the fact that global aspects of the configuration (which are not directly perceivable by inhabitants) have a significant bearing on movement patterns, over and above the directly perceivable qualities of the environment (Bafna, 2003; Haq & Zimring, 2003; Peatross, 1995; Peponis & Wineman, 2002). More about space syntax research methods is described in the next chapter.

In the following section, evidence linking local, relational and global path characteristics with where people walk is reviewed. As discussed earlier, the studies that examine the relationship between environmental factors and participation in walking may also be relevant to our understanding of where people choose to walk and are reviewed here.

Local and relational path characteristics

Local path characteristics occur in a specific path or path segment, and are qualities of a particular path independent of any other paths that it may be connected with (such as path length, path gradient, presence of sidewalks etc.). *Relational* characteristics are qualities that a path possesses because of it relationship with spaces that are immediately surrounding it such that there is a visual relationship between the path and its surroundings.

Relationship with where people choose to walk

Studies conducted among people with disabilities (including older adults) show that people with disabilities tend to avoid walking in places that offer challenges such as stairs and long distances (Patla & Shumway-Cook, 1999; Shumway-Cook, et al., 2003). This is consistent with the Press-competence theory according to which individuals tend to adapt to environmental demands based on their level of competence (Lawton, 1982). According to this theory, the same environment that appears challenging to an individual with lower competence (e.g. due to poor vision) may be optimum for another individual. Thus, if an environment such as a retirement campus is designed such that there are varying levels of environmental challenge, it is possible that spaces that are more challenging (e.g. long paths, paths with steep slopes) are used for walking by more able residents while spaces that are less challenging (e.g. internal paths, paths with flat slopes) are used more often by people who face some sort of physical limitation to walking.

A few studies, mainly case studies of residential facilities for the elderly, provide suggestions about incorporating spaces for walking. For example, Regnier (2002) suggests incorporating ‘walking therapy’ into building design – a corridor system with seating every 35-40 feet connecting interesting destinations. Other studies suggest people will be found walking along corridors with views into activity areas and to outdoor areas (Howell, 1980; Parker & Joseph, 2003; Regnier, 1994). Regnier (2002) suggests that locating a bench on a stair landing can also encourage residents to use stairs for exercise. There are no empirical studies documenting how stair characteristics may be related to use of stairs by older adults for recreation or as part of a route taken to get somewhere.

Relationship with participation in walking/walking levels

Studies of the environmental correlates of physical activity among older adults indicate that some local environmental factors are linked to increased physical activity at the neighborhood scale. For example, researchers have found that *safety* from crime and safety of footpaths for walking are related to increased physical activity among older adults (Booth et al., 2000; CDC, 1999). *Aesthetics* and attractiveness of the neighborhood (Ball, Bauman, Leslie, & Owen, 2001; Brownson et al., 2000; Wilcox, Castro, King, Housemann, & Brownson, 2000), is also a key environmental factor that is associated with higher physical activity levels. Ball and colleagues found that men and women reporting a less *aesthetically pleasing* or less *convenient* environment were less likely to report walking for exercise or recreation in the past 2 weeks (Ball et al., 2001). *Barriers* to physical activity among older adults –have been stated as fear of crime, bad weather, poor or no sidewalks and no places to sit down (Clark, 1999; Henderson & Ainsworth, 2000).

Clearly, there are few studies looking at walking among older adults. And the studies that exist are varied in terms of their focus and findings. Thus, one set of studies discussed above looks at broad environmental factors such as aesthetics/attractiveness, convenience and safety – these are perceived characteristics of the overall environment that was being studied and not characteristics of the path or route where people walked. Also, these studies do not go into depth about what these concepts really mean in terms of physical environmental design features. Other studies looked at barriers to walking and these begin to address more closely some of the issues that may be important to consider while designing environments for walking among older adults such as – sidewalks, places to sit, protection from the weather, length of routes and presence of obstacles such as steps. The other studies from the architecture field provide guidelines and suggestions for designing spaces that support walking. However, these suggestions are based on informal observations of behavior in these settings and not on empirical studies. However, these observations and suggestions are valuable, given the fact that they are based on close observations of behavior of older adults, and merit further investigation.

Global Path characteristics

Global characteristics of paths are characteristics that a path possesses because of its location/position within the network of paths. These are the systemic or the structural properties of the spatial unit (Haq & Zimring, 2003). The space syntax research program provides a way to configure a space – or turn a continuous space into connected set of discrete units (Bafna, 2003) (More about the method of converting a space into discrete units in Chapter 3). The spatial units, thus organized have different properties which are characteristics of the larger system of units that it belongs to.

Relationship with where people walk

Depth measures the number of steps (spaces) that need to be taken to get from one space to others in the system. This variable is highly correlated with movement (Bafna, 2003; Hillier, 1996; Peponis & Wineman, 2002). Spaces that are just a few steps from all others in the system are termed as integrated in space syntax research while spaces that can be reached only by traversing several other spaces are segregated. Research suggests that spaces which are more integrated are also likely to be spaces with more numbers of people moving through. Though this argument has been provided in the context of large urban grids, other studies (Choi, 1991, Peatross, 1994, Haq & Zimring, 2003) showed that the relationship between integration and patterns of movement held true in buildings as well. Spaces that are deeper within a system are likely to be less accessible to users and according to space syntax that will also be evident by the lower levels of movement observed in these areas (Bafna, 2003; Peponis & Wineman, 2002). Such spaces are also likely to be perceived as being at a greater distance from the origin. On the other hand when facilities such as exercise rooms are visually and physically accessible (located along integrated routes), they are also likely to be perceived as more accessible and easier to reach.

Most space syntax research studies have assessed distribution of people in a setting (people moving through a space) and do not specifically look at purposeful walking (for recreation or to get to a destination). However, there may clearly be some relationships between structural characteristics of paths within a layout and path choice for walking that are relevant to this current study, especially when we consider that access to destinations has been identified as a key factor linked to physical activity in many studies.

Relationship with participation in walking/walking levels

Researchers have identified convenience and access to destinations as key factors affecting walking levels among older adults living in traditional neighborhoods. King and colleagues (2003) found that older Caucasian women (mean age= 74.2 years) who lived within walking distance (defined as within a 20 minute walk of home) of a park, biking or walking trail; or department, discount or hardware store walked more (higher pedometer readings). Also, individuals who had a higher number of destinations within walking distance of home tended to have higher activity levels (as measured by a pedometer and questionnaire) than individuals with fewer destinations near their home (King, et al., 2003). Carnegie (2002) found that neighborhood dwelling older adults who reported shops, beaches and parks closer to home tended to walk more than neighborhood dwelling older adults who did not. A longitudinal study conducted in Japan found that older adults who lived within walking distance of green areas and tree lined streets lived longer (Takano, Nakamura, & Watanabe, 2002). Other studies found that access to facilities was related to physical activity levels among community dwelling older adults, though access is not well defined in these studies (Booth et al., 2000; R. Brownson et al., 2000; Wilcox, Castro, King, Housemann, & Brownson, 2000). Brownson and colleagues (2000) found that the ‘convenient location’ of trails was associated with increased trail use.

These studies suggest that ease of access to resources measured in different ways – ‘within walking distance’, ‘convenient location’ – is associated with older adults walking more. The presence of interesting destinations within *‘walking distance’* appears to be related to how much older adults walk at the neighborhood scale. But it is not clear how walking distance is defined – is it the shortest metric distance between origin and destination or is it perceived distance – which may be more or less or the same as metric distance and is a characteristic of the layout. Other factors such as ‘convenient location’ and ‘ease of access’ may also be aspects of the layout and the actual routes available that define how easy or difficult it is to reach a place.

Regnier (2002), based on extensive case studies of several residential facilities for older people, suggests that continuous walking loops (that start and end at one point) may support walking among older adults. In fact, he suggests, *“the corridor system should be conceptualized as a series of paths and destinations so that residents will find it interesting to walk from one place to another. The walking for exercise pathway system should be thought of as having three parts: 1) interior corridors, 2) exterior on site pathways and 3) off-site excursions into the neighborhood and adjacent properties*” (Regnier, 2002). No studies have defined in objective and empirical terms the aspects of these pathways that may make them ‘interesting’ or supportive for walking. Further, there are no studies that look at how such a walking system may be integrated into the system of paths within a particular geographical area, be it a campus or neighborhood.

2.4 Summary and discussion

Physical activity is extremely beneficial for older adults and walking is the most popular physical activity for older adults. Evidence from several different fields suggests that in addition to personal, social and organizational or policy related factors, the physical environment plays an important role in supporting or inhibiting participation in physical activity. Most of the studies to date have examined the relationship between the environment and participation in physical activity at the neighborhood and urban scales and only a handful of these have examined these issues in the context of older adults. Only one study has examined how the environmental characteristics of sites and buildings are associated with the number of older adults participating in physical activity. These studies provide a general idea about the types of environments where older adults are likely to be more active. However, they provide little information about the actual location of physical activity – where are older adults walking and what is it about those spaces that support walking?

Residents in residential communities vary in terms of physical abilities – some residents experience disabilities that limit their walking to protected, supportive settings while other residents may be perfectly healthy and able to navigate complex and challenging environments. Thus, residents with different abilities may choose to walk in different types of environments that provide the optimum balance of support and stimulation they are capable of adapting to. However, no studies have assessed where older adults choose to walk and how the characteristics of the environments may be associated with their choice of paths for walking. This information is critical to designers of environments for older adults who are faced with the challenge of creating environments that on the one hand provide support to those who need it, but can also stimulate and challenge individuals capable or responding to those challenges.

Local characteristics (such as path condition and maintenance), relational characteristics (such as views to other spaces from path) and global characteristics (that determine how easy it is to reach other spaces from any space) of paths are associated where people choose to walk. Further, it is plausible that people choose to walk in different types of environments depending on whether they are walking to get to a destination or if they are walking for pleasure or recreation. However, no studies have examined this relationship in the context of older adults.

The purpose of this thesis is to understand where older adults in retirement campuses choose to walk for recreation or to get to a destination and the environmental factors that may be associated with their decision to choose certain types of paths over others.

CHAPTER 3

OUTLINE OF RESEARCH

3.1 The Context: Continuing Care Retirement Communities

The phenomenon of walking was studied in the context of older adults living in *continuing care retirement communities* (CCRC). A CCRC offers two or more levels of care in a residential setting. Usually residents enter the CCRC when they are still independent and able to enjoy the social opportunities available at the community. At this point they are usually ambulatory and capable of managing their affairs independently. As their needs for care increase, they may move from their apartments to assisted living or skilled nursing care units on the same campus. Most CCRCs provide a range of social and recreational opportunities to their residents on campus and it is becoming increasingly common for new CCRCs to incorporate a ‘wellness center’ which provides health services, exercise facilities, swimming pools etc. Thus, CCRCs typically comprise of different buildings housing different functions (residential, administrative, recreational, religious, etc) and connected through a network of paths and roads within a defined campus boundary. The self-sufficient village like quality of the CCRC campus makes it particularly suitable for case study.

There are an estimated 2,600 CCRCs in the United States . Most CCRCs are located in urban or suburban locations—69% and 12%, respectively. About three-quarters are not-for-profit organizations . There are currently 340 CCRCs across 34 states and the District of Columbia accredited by the Continuing Care Accreditation Commission (CCAC), accounting for about 14% of all CCRCs nationwide. The CCAC, housed within the Commission on the Accreditation of Rehabilitation Facilities (CARF) accredits CCRCs and issues a “seal of approval” to facilities that meet certain standards.

More than 660,000 Americans live in CCRCs. According to a 2004 survey of a representative sample of 759 non-profit CCRCs and other senior housing providers (response rate 52% - 398/759) by the American Association of Homes and Services for the Aging (AAHSA) and Georgia Tech (Joseph, Zimring, Harris-Kojetin, & Kiefer, 2006 (forthcoming)), the average age of residents living in independent living at these facilities is 82, compared to 85 for both assisted living and 86 for nursing care. Most of the campuses were either located in small cities (27%) or suburban areas (23%). The campuses vary in size (acreage) with 47% of the campuses being more than 25 acres. About half the campuses in the sample are less than 30 years old. Majority of the campuses are either entirely flat or are mostly flat with some gradual slope (Table 3.1).

Table 3.1: Characteristics of a representative sample of non-profit CCRCs and other service providers in the United States (Joseph, et al., 2006)

Characteristics of responding facilities		Overall Distribution	Distribution of CCRCs
Levels of care offered[1]	AL & IL NC & IL All three levels	12 % 16 % 72 %	7% 11% 83%
Average age of residents (years)	Independent Living residents Assisted Living residents Nursing Care residents	82 85 86	82 86 87
Average # of residents	Independent Living residents Assisted Living residents Nursing Care residents	157 45 82	149 37 63
Location[2]	Urban-large Urban-small Suburban Rural	14 % 27 % 43 % 16 %	15% 27% 45% 13%
Campus Size (acreage)	<5 acres 5-25 acres 26-50 acres 51-100 acres >100 acres	16 % 37 % 24 % 14 % 9 %	9% 37% 26% 17% 11%
Campus age	1-10 years old 11-30 years old 31-40 years old >40 years old	10 % 39 % 16 % 35 %	11% 41% 15% 33%
Campus terrain	Entirely flat Mostly flat with some gradual slopes Some hills Very hilly	31 % 51 % 12 % 6 %	25% 55% 14% 6%

[1] IL – Independent Living, AL – Assisted Living, NC – Nursing Care

[2] Urban-large – located within city limits of city with a population exceeding 500,000
Urban-small – located within city limits of a city with a population up to 500,000
Suburban – located within 50 miles of small or large urban population
Rural – no small or large urban population within 50 miles of the campus

Seventy three percent of the campuses consider themselves a CCRC. The characteristic of the CCRC campuses are also shown in this table below. The CCRCs were similar to the nationwide sample that included other senior housing providers. However, 83% of the CCRCs provided all three levels of care (versus 72% in the larger sample), had fewer number of residents in each level of care and were larger (54% of the CCRCs were over 25 acres versus 47%). Also, a higher percentage of CCRCs were newer (built in the last 30 years).

3.2 Population Studied

A recent study of CCRCs conducted by Georgia Tech and AAHSA found that independent living residents are the most active and more independent living residents tend to walk on their own and perform other physical activities as compared to assisted living or nursing care residents (Harris-Kojetin, Kiefer, Joseph, & Zimring, 2005). They also found that the relationship between the presence of environmental resources and features and participation in physical activity was the strongest in the case of independent living residents. Based on these findings and findings from preliminary case studies (Parker & Joseph, 2001), this thesis focuses on walking behavior of independent living residents. Independent living residents in CCRCs live in apartments and cottages on campus, are ambulatory and perform all activities of daily living independently.

3.3 Unit of analysis

Each CCRC campus, with its network of paths inside and outside buildings were assessed as a part of this study. Since the focus is on how the characteristics of the overall network of path segments and attributes of paths are related to where older adults choose to walk, the unit of analysis is the *path segment*. The path segment is the unit that possesses certain local, relational or global qualities. Further, walking behavior will also be assessed in terms of the overall route that people take – the route taken to get to or from one point to another may traverse several path segments. Thus, it becomes important to define a path segment in the context of this study.

A **path segment** is a section of the path between two decision points. That is, a path segment ends whenever the need arises to make a decision about the path of travel (e.g. at an intersection). If steps are encountered along a path of travel – it is considered part of the path (segment 2 in Figure 3.1). If a flight of stairs is encountered off the path of travel (segment 3 in Figure 3.1), it counts as a decision point and will be regarded as a separate segment (connecting two different floor levels)

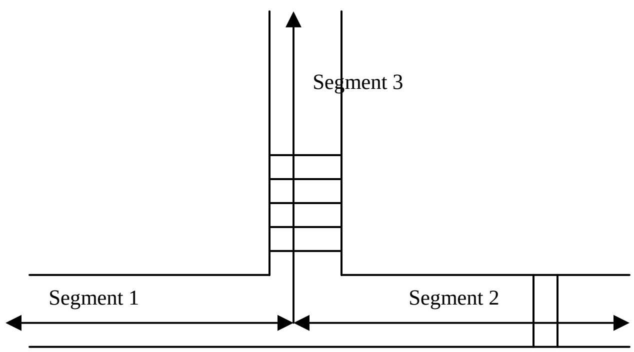


Figure 3.1: Definition of path segment used in this study

The rationale for decomposing a layout into discrete components such as path segments and studying the relationship between these components comes from the Space Syntax research program. Analytic approaches such as Space Syntax developed to study the relationship between spatial configuration and human behavior potentially provide a methodology for analyzing site and building configurations and their relationship with movement patterns within facilities for older adults. Space syntax treats built space morphologically, or according to a pattern of permeability, visibility and connection that is established between one part and another or between part and whole (Peponis & Wineman, 2002, Bafna, 2003). The basic analytical technique in space syntax involves the decomposition of a given layout into discrete entities which has several numerical measures derived entirely from their spatial interrelationship and these can be computed. Thus, continuous space may be decomposed to entities that can be represented graphically (Bafna, 2003).

In order to analyze plans syntactically, they are represented to define certain relationships clearly. Two main representations – the convex map and the axial map - have been used successfully in applied studies.

- The *convex space* comprises the fewest and largest convex shaped spaces that are required to cover all the areas under analysis. Based on this set, a graph can be constructed by identifying each convex space with a node and each accessible connection between spaces with an edge (Bafna, 2003).
- The *axial map* on the other hand comprises the fewest and longest lines that are required to cover all the convex spaces and the connections of permeability between them. The axial map can also be represented as a graph in which each line represents a node and each intersection an edge (Bafna, 2003).

The axial line is based on the notion that the line of sight is a significant unifying device in experience and that the number of distinct turns on a route (change of direction at the intersection of two axial lines) are more crucial to spatial experience than actual distance covered (Bafna, 2003). Lines are suitable in the current study because our focus is on movement, and measures such as depth in space syntax provide a good sense of how spaces can be reached by moving through a system of spaces. However, in this study, the selected unit of analysis was not the traditional axial line, but rather a linear element that lies between adjacent decision points (definition of path segment). The reasons for defining the line in this way are both theoretical and practical:

By defining the segment in this way, problems of spatial auto-correlation are resolved. Some axial lines might lie between two axial lines (for example, where the path curves) where the only way to get from the axial line before it to the one after it is through it.

However, when the linear element lies between decision points this problem is solved as there is always a choice when moving from one line to the next.

As mentioned earlier, the axial line was developed based on the assumption that movement patterns are closely linked to the line of sight. The concept of the axial line was developed to study patterns of movement in dense urban settings with high vertical boundaries (walls of buildings) on both sides of the movement path. However, the settings that are being studied in this thesis are unlike this. Especially, the outdoor paths through campus pass through open green areas where the curves and changes in direction of a path can be seen before physically reaching it. Thus, the axial line does not accurately represent the line of sight in such settings and was considered unsuitable for this study.

This definition of the line segment also allows a cleaner interpretation of the linear map. In the graph derived from the linear map, the edges always represent points of *choice* (unlike the graph from the axial map). Since the question here is what type of segment was *chosen* for walking, this avoids giving extra weight to segments that are not on choice nodes.

Within each community path segments were assessed independently to understand if there was a relationship between path use and path characteristics. The three case studies were also compared to assess if findings are replicated across them.

3.4 Case Study Selection

This dissertation uses a multiple case study method, where three CCRCs were studied. A multiple case study method was used to see if findings were replicated across the three settings. An additional facility (not officially a CCRC but provides three levels of care on one campus) was selected as a pilot test site. For logistical reasons sites within one and half hour driving distance of Atlanta were chosen for case study.

Six campus-type retirement communities located in the state of Georgia were initially identified for study. These facilities were all campus type continuing care retirement communities within driving distance of Atlanta. From this set, three facilities were contacted and permission obtained for study. Plans of all six campuses were obtained and an initial visit was made to each of the campuses to assess the similarities and differences between campuses and to get a first impression of resident activity level on campus. These visits were primarily conducted in November - December 2004. The first visit was also used to initiate dialogue with the facility administrator in order to obtain permission for the study. Since the goal of the dissertation was to understand how characteristics of paths in retirement communities were associated with where people choose to walk, three facilities were selected that were similar in size (acreage), campus terrain, age of campus, type and number of amenities available and type of residential units present on campus. The facilities selected varied in terms of the number of path segments and the distribution of path segments (layout) on campus. A fourth facility was selected as a pilot test site and more is discussed about that in this section. The remaining two facilities were not included in the study as in one case permission was not granted for study and in the other case, the campus was very large – over 100 acres.
Code names given to them are PS, PV and LV. A fourth campus consented to be the pilot test site for the study. The project was approved by the Human Subjects Review Subcommittee of the Georgia Tech Institutional Review Board.

Table 3.2 compares characteristics of the three selected case study sites to the characteristics of the CCRCs in the nationwide sample of CCRCs and senior housing providers.

Table 3.2: Comparison of case study sites with nationwide sample of CCRCs.

Characteristics of responding facilities		Distribution of CCRC in nationwide sample	PS	LV	PV
Levels of care offered	AL & IL NC & IL All three levels	7% 11% 83%	All	All	All
Average age of residents (years)	Independent Living residents Assisted Living residents Nursing Care residents	82 86 87	78	77	83
Average # of residents	Independent Living residents Assisted Living residents Nursing Care residents	149 37 63	350	331	129
Location	Urban-large Urban-small Suburban Rural	15% 27% 45% 13%	Suburban	Suburban	suburban
Campus Size (acreage)	<5 acres 5-25 acres 26-50 acres 51-100 acres >100 acres	9% 37% 26% 17% 11%	54 acres	87 acres	60 acres
Campus age	1-10 years old 11-30 years old 31-40 years old >40 years old	11% 41% 15% 33%	2 years	5 years	19 years
Campus terrain	Entirely flat Mostly flat with some gradual slopes Some hills Very hilly	25% 55% 14% 6%	Some hills	Some hills	Some hills

The table above shows that the three case studies were similar to other CCRCs in that they provide three levels of care on the same campus. However, the average age of IL residents at PS and LV was less than the national sample. These campuses also had more IL residents and were newer than the CCRC campuses in the nationwide sample. PV was more similar to the nationwide sample in terms of average age of IL residents, number of IL residents as well as age of campus (41% in national sample are between 11 and 30 years old). In terms of size all three facilities were medium to large facilities. However, since this study focused on campus type communities – most of which are located in suburban or rural areas, this size of campus is typical of campus type communities. Around 68% of the communities between 51 and 100 acres were suburban or rural – like the campuses selected for case study.

All three communities selected described themselves as continuing care retirement communities. Two of the communities – PV and LV - are not-for-profit with religious affiliation while the third (PS) was developed by a for-profit organization. All three communities provide three levels of care on campus.

In terms of physical characteristics, the campuses selected were medium sized, ranging from 54 acres PS) to 86 acres (LV). The three selected campuses all have path segments with a range of terrains from completely flat to hilly. All campuses have separate apartment buildings and cottages for independent living residents. Assisted living and nursing care residents live in a different building in close proximity to the apartment buildings. All three communities provide a range of amenities and services to residents including exercise rooms, dining services, classrooms, beauty salons etc. All three campuses have a dedicated wellness center with exercise rooms, equipment and swimming pool. All three campuses have a central dining room for all residents. In LV and PS, the central dining room is located in a separate ‘clubhouse’ building along with other amenities. In PV, the dining room is located in the apartment building. LV and PS provide a defined number of meals to all residents as part of their monthly rent. In PV, meals are included in rent only for apartment residents. Cottage residents are required to buy a meal plan which allows them to have a certain number of meals in the dining room in the apartment building.

In PV and LV, amenities are clustered either in resident apartment buildings or in a separate building designated as a village center or clubhouse. In PS, all amenities are clustered in the clubhouse or the fitness center. Thus, all communities have a clustering of amenities in two locations.

Two of the campuses – PS and LV are very new having been built in the last 5 years. PV was started in 1987, though parts of it such as the village center are less than 5 years old. PV has 100 units for independent living residents while LV has 333 units and PS has 242 units.

In terms of plan configuration, all buildings (except cottage and duplex units) are connected through internal passageways in PS and LV. In PV, the village center designated for activities is not connected to any building. In all campuses – the apartment buildings are mid rise – between 4 to 6 floors in height. The number of paths on campus varies – PS has the maximum number of path segments while PV has the fewest.

In addition to the three case studies, an additional facility (one of the six initially selected) was contacted to participate as a pilot test site. The pilot test site also provides three levels of care on campus, though it does not identify itself as a CCRC. At 64 acres, it is about the same size as the three case study sites. The pretest site is also a non-profit facility. However, this facility is much older than the case study sites and is less expensive (lower rent and no upfront fee) than the other three communities. A range of activity programs are provided to residents on campus, though this facility has fewer amenities as compared to case study sites. This facility however, has a range of different types of walking paths on campus and has a fairly active resident population. The willingness of the facility to participate in the study and ease of access and sufficient variety in path type and configuration on campus were key factors for selecting the fourth community as the pilot test site.

3.5 Research Design

This study used a case study approach to explore the proposition that path characteristics may be related to where older adults choose to walk. The case study approach enables first hand study of the phenomena of walking among older adults in their natural setting, to obtain direct evidence from older adults about their behavior and facilitates collection of data related to path segments and routes on site. Also, the focus on the 'how' questions to uncover the nature of the phenomena as well as a focus on contemporary events makes a case study approach suitable for this thesis .

The data collection was conducted in two phases. During the first phase the study was conducted at the pilot test site. Based on the feedback from the pilot test, study instruments were modified and the study conducted at the three case study sites selected.

Data collection was done during the months of May and early June at all three case study sites to minimize the impact of weather as a factor affecting variability in resident walking behavior between sites. Further, early summer was selected for case study so that extreme hot or cold weather could be avoided.

As mentioned previously, this study assessed environmental path characteristics that may be related to where people choose to walk for recreation or for getting to a destination. As such, data was obtained on three main types of variables:

- **Path use for walking:** Resident questionnaire
- **Local and relational path characteristics:** Objective path assessment and analysis of campus and building plans
- **Structural global path characteristics:** Analysis of campus site and building plans

In addition, structured interviews were conducted with the administrative head or activities coordinator to obtain additional information about the campus, its residents and types of activities offered on campus.

3.5.1 Path use for walking

This study focused on where older adults choose to walk. Further, older adults may choose different routes for walking depending on whether they are walking for recreation (exercise or leisure) or for instrumental reasons where they are walking to get to a destination. As mentioned earlier, in order for older adults to accrue health benefits from walking, the duration of the walking trip must be at least 10 minutes, adding up to a total of 30 minutes over the course of the day. Thus, in order to understand which paths and routes were used for walking, this study looked at where people walked for recreation or to get to destination during trips that lasted at least 10 minutes at a time.

Table 3.3: Operational measures for studying where people choose to walk for recreation and to get to a destination

Construct	Operationalized measures	Data collection method	Questions asked
Where people walk for recreation	Path segment use for recreational walking	Resident questionnaire	Route taken by resident during a recreational walking trip (indoor and outdoor) taken in the last 7 days that lasted at least 10 minutes.
Where people walk to get to destinations	Path segment use for walking to destinations	Resident questionnaire	Route taken by resident during a trip to two key destinations on campus taken in the last 7 days that lasted at least 10 minutes.

In this study, information about path use for walking was obtained through resident questionnaires that asked questions about the routes residents took while getting to a destination or while walking for recreation/exercise. Information about the last walking trip (for recreation of instrumental reasons) taken by the individual in the last seven days was asked. Further, only walking trips that lasted at least 10 minutes were included. Information about path segment use was obtained from the route use information. That is, if a route was used once during a trip (recreational or to get to destination) then the path segments that comprise the route were also each used once. If a resident walked along a route and came back along the same route, then each path segment comprising the route was used twice and so on.

The key outcome variables were thus, how often a path segment was used for recreation or for getting to destinations:

Path segment Use for instrumental reasons: The number of times the path segment was used (walked upon) during the course of two walking trips to destinations on campus in the last seven days.

Path segment use for recreation: The number of times the path segment was used (walked upon) during the course of the last walking trip for recreation/exercise (indoor and/or outdoor) taken in the last seven days.

<u>Resident Questionnaire:</u>

A questionnaire was developed to obtain quantitative and qualitative information from residents about their route choice for walking, key demographic data and information on physical activity levels (Appendix A.1).

Specific time slots and location (e.g. activity room) for administering the questionnaire were set in discussion with the activity coordinator at each case study site. Residents were informed about the study through fliers in the mail and the event was put on the monthly calendar of each facility. In addition a poster advertising the survey was posted in key areas to inform and remind residents on the days of the study. In all three facilities, it was advertised that a study on campus design and walking was being conducted by a Georgia Tech student. The activity coordinators at the three communities provided feedback and approval for the fliers used in the study. The room or space, designated for the study was located in a public area of the facility where it was clearly visible to residents as they went about their activities (such as collecting mail). Interested residents then came to the designated location and filled out the questionnaire under the supervision of the researcher. Residents filled out the questionnaire on their own. However, they were informed at the beginning that they were free to ask the researcher if they required clarification or help. Respondents were also informed of their rights as a research subject and signed an informed consent form. Since participation in the study was completely voluntary and the project was advertised as a study on campus design and walking, there is a possibility that residents who volunteered were the ones who perceived themselves as walkers or wanted to voice their opinion about positive or negative aspects of the campus design.

The purpose of the questionnaire was to identify where residents walked based on their intention (recreational or to get to a destination) and how often they walked during a week to fulfill this purpose. In addition, basic descriptive data was sought about the resident's age, gender, location of residence and health and functioning. The focus of the survey was on understanding where people walked (for trips that lasted at least 10 minutes at a time). Specific questions addressed the different types of walking behavior.

Instrumental walking – residents were asked how often they walked to two specified destinations on campus (in two distinctly different locations) in the last seven days and the route they took the last time they walked there from their apartment and back. Thus questions targeted at understanding where residents walked for instrumental purposes asked:

- Whether they walked to two specific destination in the last seven days (the dining room was a destination at all three facilities)
- How often in the last seven days they walked to the destination.
- The route they took to get to their destination and back the last time they walked there.

For the last part, residents were asked to either mark on the map where they walked or to choose out of a set of alternative options available (when few logical routes were available for walking to the destination) for getting to the destination. For each community, campus level and building level maps were drawn with the relevant information to enable that the information could be read and interpreted easily by residents.

Recreational walking: Residents were asked questions about walking for recreation both outdoors and indoors. They were asked whether they had walked for exercise or recreation for at least 10 minutes in the last seven days and the number of times they had done so. Residents were asked to mark on the map of the campus the route they took the last time they had walked for exercise or recreation. For both indoor and outdoor routes, residents were asked their reason for selecting the route. This was an open ended question aimed at understanding why residents chose their path for walking.

The questionnaire was tested among a limited number of respondents during the pilot test phase. The respondents were asked to identify potential problems encountered in understanding questions, differences in respondent's and researchers understanding and other issues. Specifically, issues related to understanding and using maps to describe routes taken was assessed. Based on the feedback from the pilot test site, several questions were modified and simplified. Additional questions were included where necessary.

Also since, each community had a distinctly different campus; plans had to be drawn up specifically for each campus. The researcher visited each site and walked around the entire site to identify differences if any between on-site features (such as location of paths, missing paths etc.) and the features as shown on the plan provided to the researcher. At the time, the researcher also met with the activities coordinator and confirmed names of different spaces in the community. Based on the information, the plans were simplified and redrawn to enhance comprehension. The plans were then incorporated into the questionnaire and pre-tested with 4-5 residents on that campus to ensure that the plans were clear and residents were able to orient themselves to key locations – such as their residence and key activity areas (e.g. dining room). This was a very useful exercise and in all three cases resulted in improvement in the plans and some minor modifications to the survey.

In addition, the resident questionnaire also included demographic questions and questions about resident physical activity levels. Demographic questions include questions about age, length of residence at community, whether or not they use assistive devices for walking and whether they had experienced any health problems recently (in the past 6 months) that affected their walking behavior.

The International Physical Activity Questionnaire (IPAQ) (Booth, 2000) was used to obtain data on physical activity levels of residents in the community. The IPAQ comprises a set of 4 questionnaires. Long (five activity domains asked independently) and short (four generic items) versions for use by either telephone or self-administered methods are available. The IPAQ has been tested extensively for reliability and validity across 12 countries. However, the IPAQ was primarily designed to be used with young and middle aged adults (15-69 years). It has not been tested with an older population. The only reliable survey instrument available to measure physical activity levels specifically among older adults – the CHAMPS (Community Healthy Activities Model Program for Seniors) (Stewart et al., 2001) from the Institute of Health & Aging is an extensive nine-page questionnaire. Though this is more age-appropriate and has been tested with the older adult population, the length of the survey made it unsuitable for inclusion in the resident questionnaire. The researcher decided to use the short form of the IPAQ for its simplicity and ease of inclusion in the main body of the resident questionnaire.

The short form of the IPAQ asks questions about frequency of participation (days per week) in the last 7 days in three specific types of activity a) vigorous physical activity, b) moderate physical activity and c) walking and the duration of each activity (minutes or hours per day) and sitting (Appendix A.2). The questions were structured and asked in exactly the same format as the IPAQ short form. The only variation was that font size was increased to make the text more reader friendly.

The items were structured to provide separate scores on walking; moderate-intensity; and vigorous-intensity activity as well as a combined total score to describe overall level of activity. Computation of the total score requires summation of the duration (in minutes) and frequency (days) of walking, moderate-intensity and vigorous-intensity activity. Based on the computation, respondents were categorized as insufficiently active, sufficiently active and highly active (method for calculating activity level in Appendix A.2).

3.5.2 Environmental Characteristics of Walking Paths

The previous chapter discussed how local, relational and global characteristics of walking paths may be related to where people choose to walk. Thus global characteristics of path segments that determine the ease with which other spaces can be accessed within the larger network of paths may be related to where people choose to walk. Local characteristics of path segments such as path condition and maintenance, path gradient, presence of amenities such as benches and so on may be related to people's choice of walking paths. Relational characteristics of paths that afford views to other destinations and attractions or views to people may also be related to where people choose to walk. The global, local and relational characteristics of walking paths that may be related to older adults' choice of paths for walking are listed here along with how they are measured in this study.

3.5.2.1 Local and Relational Path Characteristics

Previous research has suggested that many local and relational environmental path characteristics may be related to path choice for walking (Howell, 1980; Regnier, 1994; Patla & Shumway-Cook, 1999; Pikora et al., 2002; Parker & Joseph, 2003; Shumway-Cook, et al., 2003; Boarnet, Day, Alfonzo, Forsyth, & Oakes, 2006 (forthcoming); Day, Boarnet, Alfonzo, & Forsyth, 2006 (forthcoming)).

The local path characteristics (likely to be related to path segment use in retirement communities) that were assessed in this thesis include:

1. Path type (indoor, outdoor or transition path)
2. Path length
3. Path location (of indoor and outdoor path segment)
4. Path material (of indoor and outdoor path segments)
5. Path gradient
6. Path condition
7. Presence of street crossing

8. Presence of path obstructions
9. Presence of steps in the segment
10. Path continuity
11. Protection from the weather
12. Presence of glare
13. Presence of amenities
14. Presence of destinations along segment
15. Type of destination present along segment

Relational path characteristics refer to those characteristics of path segments that relate the segment to its immediate surroundings. Thus, parts of a setting that are not located on a path segment may be visible from a path segment. The types of views that can be seen from a path and the variations in view (different types of views) may provide the walker a sense of orientation and location and also increase his/her pleasure in walking. The attractiveness or aesthetic quality of a path or route may be described in terms of the views that are seen from it. The relational path characteristics that were assessed in this study include:

1. The types of views that can be seen from along a path segment
2. The number of different types of views that can be seen from along a path segment

Most local and relational properties of path segments (such as path condition, path slope, etc.) can be assessed only by physically visiting the site and assessing the characteristics of each individual path segment. A checklist was developed to inventory the key characteristics of path segments so that their relationship with path use for walking could be assessed (Appendix A.3). The only local path characteristic that was not assessed using this form was the length of path segments. This data was obtained from campus and building plans of each case study site.

Path assessment checklist

The environmental assessment form is a checklist of items designed to assess the characteristics of individual path segments. The form used in this study was developed based on existing items used in either the Systematic Pedestrian and Cycling Environmental Scan (SPACES) instrument (Pikora et al., 2002) (Appendix A.5) or the Irvine-Minnesota Inventory (Boarnet, Day, Alfonzo, Forsyth, & Oakes, 2006 (forthcoming); Day, Boarnet, Alfonzo, & Forsyth, 2006 (forthcoming)) (Appendix A.6). A few additional questions developed for the checklist used in this study were specific to indoor path segments and transitional path segments. The SPACES and Irvine-Minnesota Inventory tools have been tested and refined in several sites.

The checklist itself is a one-page form with a table of items with boxes for marking responses (Appendix A.3). Prior to conducting the assessment, detailed plans of campus were obtained and all path segments on campus (indoor and outdoor) were marked and numbered. The researcher then walked around campus to check if the campus plans varied in any way from what was on the ground. Any variation in the location of path segments was noted and the plans modified accordingly. All path segments on each campus were assessed.

The researcher collected the data on path characteristics by physically walking along each path segment on campus and entering the information on a paper form. At the top of each paper form the name of the community and the path segment number (ID) were marked. Then all information relevant to the path segment was noted.

The information obtained from the path analysis for each community was entered into SPSS (Statistical Package for Sciences) version 13.0 by path segment ID number. Other path segment data (such as path segment length and path segment use) by also entered into the same file.

The key variables assessed and the questions asked in the checklist are provided in table 3.4. The definitions for the terms used in the checklist are provided in Appendix A.4. The source of the question and inter-rater reliability of the question (where available) is also shown.

Table 3.4: Local and relational path characteristics assessed using the path assessment checklist

Item description	Question	Source	Inter-rater reliability
			70% agreement of more is high
Path type	**Type of paths segment** Internal path Outdoor path Transition path	New	Unknown
Path location (a)	**For outdoor path segment** Sidewalk next to road Sidewalk within 1m of kerb Shared path with markings Shared path , no markings Path/trail through park Access lane	SPACES (modified)	High
Path location (b)	**For indoor path segments** Between resident apartments Through public spaces Internal stair/fire stair Indoor Connections between buildings	New	Unknown
Path material (a)	**For outdoor path segments** Continuous concrete Concrete slabs Paving bricks Gravel Bitumen Grass or sand Wooden planks Under repair	SPACES	High
Path material (b)	**For indoor path segments** Carpet Vinyl Tile Hardwood Stone Brick Concrete	New	Unknown
Path slope	**Path slope:** Flat or gentle	UCI, SPACES	High

Table 3.4: Local and relational path characteristics assessed using the path assessment checklist

<table>
<tr><td></td><td>Moderate slope
Steep slope</td><td></td><td></td></tr>
<tr><td>Path condition</td><td>Path condition
Poor
Moderate
Good</td><td>SPACES</td><td>High</td></tr>
<tr><td>Street crossing</td><td>Is there a street crossing in this segment?
Yes
No
N/A</td><td>UCI (modified)</td><td></td></tr>
<tr><td>Path obstruction</td><td>Are there any permanent path obstructions on this segment (e.g. poles, paths, furniture)
Yes
No</td><td>SPACES</td><td>High</td></tr>
<tr><td>Steps</td><td>Are there steps in this segment?
Yes
No</td><td>New</td><td>Unknown</td></tr>
<tr><td>Alternative to steps</td><td>If steps are present, are there alternatives to negotiating the change of grade?
Yes
No</td><td>New</td><td>Discarded as it was difficult to assess on site</td></tr>
<tr><td>Path continuity</td><td>Continuity of path
Path forms useful and direct route
Path is disjointed</td><td>SPACES</td><td>High</td></tr>
<tr><td>Covering</td><td>How much of the path is covered by these features that provide protection from sun, rain, and/or snow<table><tr><td>Feature</td><td>None</td><td>Partly</td><td>Fully</td></tr><tr><td>Roof & walls
Arcades
Awnings
Trees</td><td></td><td></td><td></td></tr></table></td><td>UCI (modified)</td><td>High (Roof & walls is new addition)</td></tr>
<tr><td>Glare</td><td>Is there glare along this path?
Yes
No</td><td>New</td><td>Removed – difficult to assess on site</td></tr>
<tr><td>Smooth threshold</td><td>Is there a smooth threshold while moving from inside to outside or vice versa
Yes
No</td><td>New</td><td>Unknown</td></tr>
<tr><td>Key card building entry</td><td>Is a key or identification card required to enter inside?
Yes
No</td><td>New</td><td>Unknown</td></tr>
<tr><td>Automatic door</td><td>Is there an automatic door or button press door available for getting in and out?
Yes</td><td>New</td><td>Unknown</td></tr>
</table>

Table 3.4: Local and relational path characteristics assessed using the path assessment checklist

	No		
Amenities	**Indicate whether the following amenities are present on the segment. Indicate the number of each feature present in the segment** Benches/chairs/ledges Trash cans Water fountain Handrails	UCI (modified)	High
Destination	**Are destinations present in the segment?** Yes No	New	Unknown
Types of destinations	**Type of destinations** Residential Shops Activity related areas Chapel Beauty salon Administrative areas Natural features Parking	New	Unknown
Types of views	**Types of views** Residential Water (river, lake) Tended nature Nature (untended) Public spaces (plaza, lobby) Destinations (not on path) Parking Artwork	SPACES (modified)	High

Additional variables created based on the data included:

- Total number of amenities
- Total number of destinations along a segment
- Total number of views from segment

Metric distance to amenities has also been identified as a local path characteristic that may be related to walking and path choice for walking. This information was obtained from building and site plans using software such as Autocad or through manually obtaining dimensions from plans of the buildings and campus.

3.5.2.2 Global structural characteristics of path segments

A path segment possesses global structural characteristics because of its location within the network of path segments. Unlike the local and relational characteristics mentioned earlier which assess qualitative aspects of a path segment, these characteristics of a segment are an aspect of the structure or layout within which the segment is located and come from the pattern of relationships within the particular network. Two main structural global path characteristics are of interest in this study – *depth* and *choice*.

The concept of depth relates a path segment to the rest of the network – to segments beyond its immediate neighbors. The depth between two segments is the minimum number of spaces that must be traversed to go from one to the other. The statistical mean depth of a segment from other segments gives a measure of the centrality of this segment with respect to the rest of the network. Based on this definition, spaces are either more or less central within the network. Path segments that are more central are more accessible. Path segments that are less central within the network are less accessible. Several studies have shown that the distribution of people in a spatial system corresponds to the distribution of mean depth values (Bafna, 2003; Hillier, 1996; Peponis & Wineman, 2002).

Choice is a measure of the likelihood for a path segment to lie on a route connecting any two path segments on campus. Thus, some path segments will lie on many routes (high choice) while others will lie on few routes (low choice).

Spatial analysis of building and site plans

Campus site and building plans were analyzed to obtain key characteristics of the configuration that may be related to walking. Space syntax methodology is already well developed and computer applications such as GIS with extensions for performing the spatial analysis, developed at Georgia Tech, are ideal for conducting this analysis (Bafna & Zhang, 2005). The GIS software allows the user to draw lines (including curves) on the plan of the campus. All line segments were drawn – indoor path segments, outdoor path segments and the connections between indoor and outdoor segments. Indoor path segments were drawn only in residential buildings and public buildings on campus. The health center or nursing care building, where residents did not walk for recreation and were not common destinations was not included in the path segment analysis. Figure 3.2 shows the campus plan of PS with the path segments drawn on it. This particular plan highlights the indoor (blue) and outdoor (red) path segments on the campus. As can be seen, the indoor path segment lines could not be drawn directly over the indoor path segments on the building plan because the floors are stacked vertically and the lines need to be staggered on the two dimensional plan space.

Figure 3.2: Plan of PS showing how line segments are drawn using the GIS software. Indoor path segments are shown in blue and outdoor path segments in red.

The pattern of relationships between line segments can then be represented graphically and in tabular form with each line segment being represented as a point or node in the network. The file extension to the GIS software calculates key structural path characteristics such as depth which measures how far each segment is from all other segments on campus. High values of depth indicate that a path segment is less central within the path segment network while low values indicates that a path segment is more central within the campus network. Additional path variables were also imported into the GIS table from the original SPSS table. This allowed the researcher to create overlays by selecting different variables to view.

This table generated by the GIS program also contains information on the connections between spaces. That is, it tells us all the segments a particular segment is connected to. This information was then translated into a matrix format and imported in to Pajek, a software designed to conduct social network analysis (Batagelj & Mrvar, 2003; Nooy, Mrvar, & Batagelj, 2005). Social network analysis is the mapping and measuring of relationships and flows between people, groups, organizations, animals, computers or other information/knowledge processing entities. The nodes in the network are the people and groups while the links show relationships or flows between the nodes. Social network analysis provides both a visual and a mathematical analysis of human relationships (Krebs, 2005). In this study, each segment was represented as a node in the network. The concept of betweenness centrality (choice) measures the likelihood of a node (path segment) falling on a route connecting any two nodes (path segments) within the network. The Pajek software was used to analyze and calculate betweenness centrality (choice) for each path segment. Path segments with high choice values were located on more routes between path segments on campus while path segments with low choice were located on few routes between segments on campus.

3.5.3 Campus organizational characteristics and demographics

In this study, the relationship between organizational and social factors and path choice were not examined in great detail. However, it was important to understand if the communities were similar in terms of types and number of programs, amenities and staff available for promoting physical activity and in terms of resident involvement in social and other activities. A form was developed to obtain key organizational and staffing characteristics and demographic characteristics of the residents in each community (Appendix A.7). The questions on the forms were based on the Resident and Staff Information Form (RESIF) and Policy and Program Information Form (POLIF) developed as part of the Multiphasic Environment Assessment Protocol (MEAP) (Moos & Lemke, 1996). The MEAP is a five-part procedure for evaluating the physical and social environments in residential settings for older adults. The procedure was designed to assess nursing homes, residential care facilities, and congregate apartments. Questions about resident background characteristics, resident participation in activities, clubs and decision making were included. In addition, questions about the services and amenities available in the facility were asked. A few key questions were asked about the structure and ownership of the facility. These questions were based on a survey developed to assess physical activity related features, programs and physical activity participation in CCRCs (Harris-Kojetin, et al., 2005). The activity coordinator at each case study site filled out the facility information form (Appendix A.7). The purpose was to obtain key demographic and organization information about each community for comparison.

3.6 Analysis

3.6.1 Statistical analysis

All data obtained from the resident questionnaires, path assessment and spatial analysis were entered into SPSS (Statistical Package for Social Sciences) version 13. Two sets of tables were created for each case study. Raw data from the resident questionnaires regarding route choice, demographic data and physical activity levels were entered into the first table. Information on path segment use (from route choice) by each resident was entered into the second table. Overall path segment use and path segment use by different categories of residents (e.g. residents using assistive devices) was calculated from the raw data in the second table. Thus, two main outcome variables (overall path segment use for recreation and overall path segment use for getting to destinations) were created for each case study. Additional outcome variables created included path use (for recreation and for walking to destinations) by different categories of residents based on –

1. gender (male and female) – two variables
2. type of residence (cottage, apartment) – two variables
3. age (72 years or below, between 73 and 80 years, 81 or older) – three variables
4. use of assistive device for walking (yes, no) – two variables
5. reported health problems in the last 6 months that influenced walking behavior (yes, no) – two variables
6. physical activity levels (insufficiently active, sufficiently active and highly active) – three variables

Thus, a total of 32 outcome variables (path segment use) were created (16 for each type of walking trip). These variables are all continuous variables. The path characteristics are mostly ordinal or nominal. Continuous path variables were path length, average distance, choice, number of views, number of destinations and number of amenities.

Preliminary analysis was conducted with each variable to assess the characteristics of the distribution. The key outcomes variables – path use for recreation and path use for getting to destinations – were not normally distributed about the mean. Thus, it was not feasible to conduct bivariate correlations with these variables. To address this issue and to increase interpretability of the findings, the Chi-square analysis was considered a more appropriate test for significance of relationships.

All outcome variables were initially classified into low, medium and high categories. However, because the variables were not uniformly distributed, it was difficult to make this classification and the definition of low, medium and high varied between the outcome variables (path segment use by different categories of residents varies greatly). Also, in all three communities, a large number of path segments were not used at all. Thus, a more logical and useful distinction seemed to be between path segments that were not used at all and path segments that had some use. Thus, all outcome variables were thus classified.

All path characteristic variables were also organized into two categories (yes/no, high/low) or more categories (flat slope, moderate slope, steep slope). Variables with more than two categories were first analyzed using chi-square analysis to assess if path use varied between these categories significantly. Then the variable was regrouped into two categories (based on where the differences seemed to lie) and chi-square analysis conducted again. This allowed the researcher to make clearer statements about how path use varied between different categories of a variable. Only relationships that were significant at 0.05 level or better were considered. Assessing path use by different categories enables us to understand if different categories of residents used path segments differently or if any unusual behavior could be observed. In each case study, only significant relationships are reported in tables. Chi-square values and p-values are also reported along with column percentages for the cross tabs.

3.6.2. Analysis of highly used path segments

The analyses described above primarily assessed if path segments that are used for recreation or for getting to destinations varied along some characteristic from path segments that were not used at all. However, in this study it was also important to identify the path segments that were used most commonly by residents to see if those particular path segments possessed some peculiar or interesting characteristics that set them apart from the other path segments on campus.

The 20 path segments on each campus that were chosen most often for walking for recreation and for getting to destinations were selected and highlighted in a different color on the campus plan. For instrumental walking, path segments were chosen based on the relative location of the destination and the individual's residence and no clear patterns were observed. Thus, the researcher decided to focus on path segments that were highly used for recreation by different resident categories to see if any interesting patterns could be observed.

Further, the 20 highly used path segments were also identified for each resident category and the plans were compared for each type of resident category (residents using assistive devices versus those not using assistive devices) to see if different types of residents preferred certain types of path segments for walking.

3.6.3 Analysis of highly used routes

To take the analysis a step further, routes that were commonly used on campus were analyzed. The commonly used routes (indoor and outdoor) on each case study site were identified and numbered. The data on route use was then entered in the resident level database and the distribution of these routes by resident type was ascertained (using cross tabs function in SPSS).

Finally, findings from analysis of path segments, highly used path segments and routes were compared across the three case study sites and patterns identified.

CHAPTER 4

DESCRIPTION OF CASE STUDIES

This dissertation deals with where independent older adults walk in campus type retirement communities. While the focus of this study is on the environmental characteristics of walking paths and how they are related to where residents walk, the study also considers the role played by individual factors and social/organizational factors in each retirement community.

This study focuses on three continuing care retirement communities located near Atlanta, Georgia. This chapter describes in depth each community in terms of its physical characteristics (campus organization, types of buildings and outdoor features, types of paths), organizational characteristics (policies with regard to physical activity, types of programs offered), social characteristics and resident characteristics. Detailed information on path characteristics is provided in the individual case studies in Chapter 5, 6 and 7. The information presented in this chapter was extracted from informal interviews with staff, from the demographic questions on the facility information form and from informal interviews with residents.

4.1 Case Study 1: PS Continuing Care Retirement Community

4.1.1 Physical Description

PS is a for-profit Continuing Care Retirement Community (CCRC) located in a suburb of Atlanta, Georgia. At 54 acres, it is a medium size CCRC. The campus opened to residents in 2004. It is located in close proximity to a famous national park. The residents at PS have direct key card access from their community to a golf course located in the national park. There are two main entrances to the campus. The main gate house is monitored by a guard, while the rear entrance is used only by residents and service vehicles.

The campus comprises several buildings (Figure 4.1). Three main residential apartment buildings are connected to a central ‘clubhouse’ through internal corridors as well as through outdoor paths. In addition to the apartment buildings or ‘villas’ as they are called, 75 cottages/duplex homes are spread over campus. The size of apartments and cottages varies. The clubhouse houses administrative and recreational functions. There is a large central dining space on the main floor (third floor) of the clubhouse where all residents are provided a certain number of meals per month as part of their monthly fee.

Figure 4.1: Campus plan of PS with adjacent state park golf course shown

Figure 4.2: Plan of the main Clubhouse floor and Villa building 1000, 2000 and 3000

In addition to the main dining facility, there is a small café and cocktail lounge on this floor. An auditorium/ multipurpose rooms and administrative offices and reception areas are also located on this floor. The second floor of the clubhouse houses functions such as a bank, hair salon, library, pool room, activity rooms and mail room. The first floor is primarily for sales and marketing and has few resident functions. The clubhouse utilizes site gradients such that the third floor of the clubhouse can be directly accessed from parking on the east side while the first floor of the clubhouse is accessed directly from the west side (facing the lake).

A fitness center with indoor swimming pool and exercise facilities that was under construction during the time of the study became operational in November, 2005. At the time of the study, the fitness center as well as internal paths from (apartment buildings) leading to it were closed off. Additional apartment buildings are planned for future development in the north-east section of the site. Other buildings on site include a health center – which provides nursing care, assisted living and dementia care for PS residents as they need it.

The three villa buildings (Figure 4.2) are connected to the main clubhouse building through internal corridors. The first floor of building 3000 connects to the third floor (main floor) of the clubhouse. The second floor of building 1000 connects to the second floor of the clubhouse (by the mail room) and the second and third floors of building 2000 connect to the second and third floors of the clubhouse.

PS also has a range of outdoor features. One of the key attractions on this campus is the man-made lake located at the center of campus (Figure 4.3b). It is visible from many parts of campus. Other outdoor features include two gardens located near the villa buildings. These gardens are landscaped with walking paths, benches, waterfall features and gazebos (Figure 4.3a). The campus also has a greenhouse and raised garden beds for residents who may be interested in gardening. A bridge over the lake connects two sides of the campus and provides an attractive short cut from the cottages to the clubhouse building. Other than walking paths through garden areas, there are well maintained sidewalks by the side of all streets on campus. Brick paved road crossovers connect sidewalks at all junctions.

Figure 4.3a: Gazebo in the landscaped courtyard between Villa buildings 2000 and 3000 (left)
Figure 4.3b:View of the lake from the path segment bordering it (right)

Two outer edges of the site are bordered by main streets. As part of the campus development, sidewalks were built along these roads such that there is a continuous sidewalk connection from the rear entrance to the main entrance of the campus from outside the campus. Views of the national park can be obtained while walking along this sidewalk.

4.1.2 Resident Characteristics

The minimum eligible age for residents to enter PS is 60 years. The median age of residents on campus is 77 years. There are 350 residents on campus, 68% of whom live in apartment buildings. This community does not collect any overall demographic information and was unable to share information on age, gender distribution, use of assistive device, ethnicity or education levels. Most residents are from middle and high income backgrounds and a majority resided in Georgia before they came to PS. There are several couples on campus, especially residing in the cottage and duplex homes, though the actual number could not be ascertained.

4.1.3 Social environment

Residents have not lived on campus for long (maximum – one year). However, there appears to be strong peer support for physical activity. There is a walking club on campus started by one of the residents. This elderly gentleman was one of the first residents on campus. He took it upon himself to walk all around campus and determine the lengths of different paths on campus. He has located interesting walking routes on a map of the campus and designated different levels of difficulty to these routes. Several residents belong to this walking club. Also, PS has a resident’s council on campus. There are 25 residents on this council that meets once a month. There are also other resident clubs on campus that oversee different aspects of resident life. A newsletter, written by residents, is published once a month.

4.1.4 Organizational environment

PS is run by a for-profit organization. It is a type A CCRC which means that residents enter into a contract with the organization where they pay an upfront entrance fee and a monthly fee. This type of contract ensures housing, assisted living and skilled nursing care to the resident at no extra costs for the entire period of their stay at PS. The monthly fee covers many different services offered by the community including maintenance of the residence, landscaping, security, utilities, biweekly housekeeping, a range of social and recreational activities and dining. As part of the monthly fee, all residents can partake of a defined number of meals in the clubhouse (formal dining or casual bistro).

‘Wellness’ is an important focus of the organization. According to the developer, resident wellness was an important factor that drove the design of the community. The facility has a wellness center with a heated indoor pool, warm therapy pool, exercise room, day lockers and showers. Many different types of physical activity programs are offered on campus including dance classes, swimming, aerobics, exercise and tai-chi. There are five full time and seven part-time staff members who organize and manage physical activity programs on campus. The activities coordinator of the community rated the physical activity programs and facilities on campus as ‘excellent’. In terms of decision making, most key decisions were made entirely by staff or by the staff with some resident input.

4.2 Case Study 2: LV retirement community

4.2.1 Physical description

LV is a not-for-profit retirement community and is designed to be the flagship of the family of 18 communities built, owned and managed as part of a larger retirement community chain in the United States. The campus was started in March 2001. It is located in the suburbs of a small town in Georgia but within easy driving distance to Atlanta. At 87 acres, LV is the largest of the three case study sites. The community is located in close proximity to Lake Sidney Lanier, the largest man-made lake in Georgia. In fact, a wooded walking trail from the campus leads to the lake. The campus has a single entry point and the gate is continuously monitored by a security guard.

The campus itself is located on a wooded hilly site. A large part of the site (north) remains wooded and there are no plans to develop that part due to the steep gradient (Figure 4.5). There are many buildings on campus. The campus is organized into two main residential buildings called the ‘East Village’ and the ‘West Village’. The Village buildings are connected to a central clubhouse building. The West village was the first to be constructed and occupied. Residents at the West Village have been living on campus for over 3 years. The East Village opened in 2005 and residents were still moving in at the time of the study.

In addition to the apartment buildings, there are 31 cottages, located in the west part of the site. A health center connected to the Clubhouse buildings provides units for skilled nursing services, assisted living and dementia care. A small enclosed garden can be accessed directly from this building. There are plans to develop garden beds for residents near this courtyard garden.

Figure 4.4: Campus plan of LV showing the East and West Village building

Each Village building has a large partially covered parking lot in front. The health center has its own parking area. A road circles around campus connecting all building and cottages. There are several outdoor spaces on campus. There is a landscaped garden with an arbor, seating areas and water feature located to the north of the clubhouse (Figure 4.4). Walking paths criss-cross this part of the site connecting the two residential buildings and the clubhouse at lower levels. A tennis court and a small pond are also located in this part of the site. There are also other garden spaces located near the first floor of the east and west village buildings. Balconies from resident apartments open onto these garden spaces. Other than the main entrance to the clubhouse and village buildings, all other doors from the outside require a key card for entry. There are paved walking paths in the landscaped garden. There are sidewalks leading from the parking lot to the residential buildings and clubhouse and health center. Other than that, there are no sidewalks along any of the primary or secondary roads around campus, though there are plans underway to develop walking trails by the side of the road that will link up with existing walking paths across campus. Overall, the campus is well landscaped and maintained with attractive views of landscaped and naturally wooded areas.

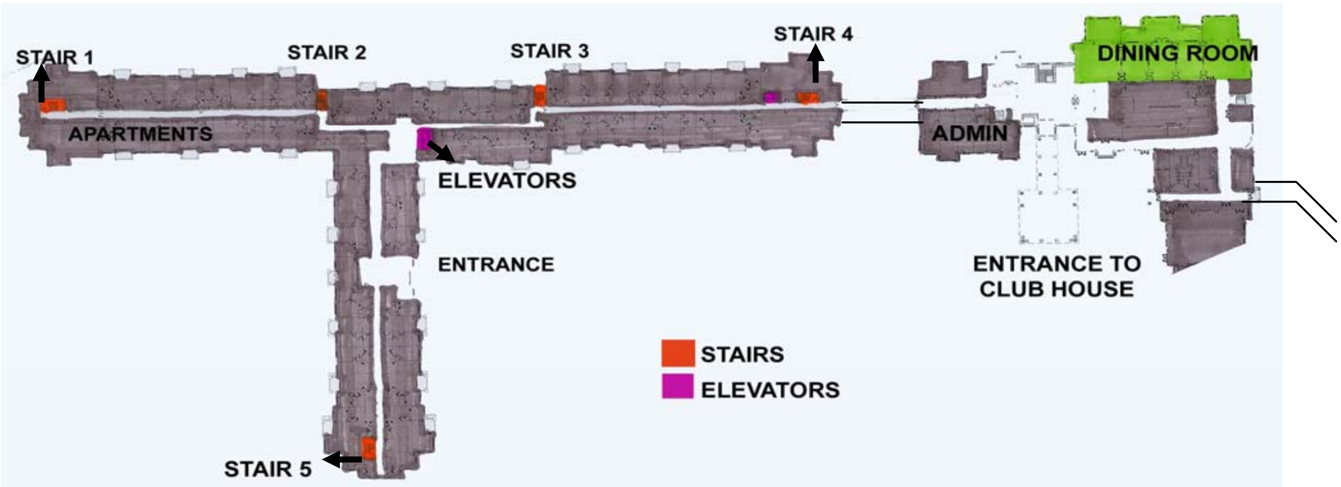


Figure 4.5: plan of 4th floor of the West Village and the main floor of the clubhouse

Each 'village' comprises of around 150 apartment units of different sizes. Each building is T-shaped with a lobby, common spaces and elevators located at the intersection of the wings (Figure 4.5). Resident apartments are located on either side of corridors. Since the corridors are extremely long (distance from stair 1 to stair 4 is around 650ft), the architects 'turned' the corridors to reduce the effect of a lengthened perspective. However, this does result in some functional problems as residents walking down the corridor cannot often see if someone in a motorized cart is turning the corner. Mirrors have been placed at corners so that people can see if someone is coming from the other side. The main entrance to the West Village (from the parking area) is on the 4th floor of the building. Residents take the elevator three floors down to use the landscaped gardens located towards the north part of the site. The main entry to the East Village building is on the first floor of the building. Both buildings are connected through internal corridors to a central clubhouse building.

Figure 4.6a: Path leading to the front entrance of the clubhouse from the parking lot (left)

Figure 4.6b: Connections between the West Village and the Clubhouse- open from the sides on the first floor and covered on the second floor (right)

Figure 4.7a: View into the swimming pool at the lower clubhouse level (left)

Figure 4.7b: View into the exercise room from the corridor at the lower clubhouse level (right)

The fourth floor and second floor of each Village building connects to the central clubhouse. The connection corridor on the 4^{th} floor is climate controlled while the connection on the second floor is open on the sides. Beautiful views of the campus can be seen while walking along the corridor connections.

The clubhouse building houses administrative, recreational and exercise facilities for all residents on campus. The upper floor of the clubhouse (the main floor) houses administrative offices, the formal dining room, chapel/auditorium, gift shop, banking services, lounges and activity room. The main entrance to the clubhouse from parking is located on this floor. Several activity related areas are located on the lower level of the clubhouse including an indoor swimming pool, exercise room with equipment, woodcraft room, card room, beauty salon, activity room and lounge. There is also a café on this floor that is open to all residents, employees and visitors.

In addition to the activity spaces located in the clubhouse there are also some important resident public spaces located in the village buildings. Each floor of the village building has a chapel/activity space directly off the elevator lobby. A double height space called the ‘atrium’, located on the first floor of West Village building is a multipurpose activity space which serves as a meeting place for several resident clubs, exercise room and exhibition space. Mail rooms for each Village building are located off the elevator lobby - on the 4^{th} floor in the West Village building and first floor of the East Village building.

4.2.2 Resident characteristics

The minimum eligible age for residents to enter LV is 62 years. The median age of residents on campus is 78 years. There are around 374 independent living residents on campus, 87% of who live in apartment buildings. Around 68% of the residents have lived on campus between one to five years. The rest of the residents had been on campus less than 6 months at the time of the study. Around 20% of the residents have some college education, 60% are college graduate and around 20% have a post-graduate degree. Nineteen percent of the residents use some type of assistive device to get around campus (25 residents use walkers, 25 residents use electric carts, 10 residents use canes and 3 use wheelchairs). Most residents are from middle to high income backgrounds and a majority resided in Georgia before they came to LV. There are several couples on campus, especially residing in the cottage and duplex homes, though the actual number could not be ascertained.

4.2.3 Social environment

There is an active resident association on campus which meets once a month. There are about 15 formal committees and 20 interest groups that are responsible for organizing programs, making decisions and determining other aspects of resident life at LV. Residents are encouraged to pursue their interests and form groups around their interests. One gentleman for instance had an entire train collection with tracks and landscaping and other features before he came to the community. He was allowed to set it up in a room in the West Village. Other residents pitched in to help build and finance the project. Now the ‘train room’ is a focal attraction for new residents, grandchildren of residents and other visitors to the facility. The gentleman and his friends have also created a smaller train garden in the courtyard located adjacent to the health care center.

There is no formal walking club on campus, though the activities coordinator had at one point, started a walking program with interested residents. The residents who participated in this program carried pedometers and marked on a map (in miles) how far (e.g. from Atlanta to Philadelphia) they walked over a period of time. This was discontinued on an active basis since residents were not able to commit to a schedule. According to the administrator several residents still kept track of their walking behavior on an informal basis. There are also other resident clubs on campus that oversee different aspects of resident life. A newsletter, written by residents, is published once a month.

4.2.3 Organizational environment:

LV is a type-A CCRC which means that residents enter into a contract with the organization where they pay an entrance fee and monthly fee. This type of contract ensures housing, assisted living and skilled nursing care at no extra costs for the entire period of their stay at LV. The monthly fee covers many different types of services including most activities on campus and a certain number of meals.

Promoting physical activity or wellness is not a stated mission of the facility. The facility has a wellness center with a heated indoor pool and whirlpool spa and exercise room with senior friendly equipment and trainer. Many different types of physical activity programs are offered on campus including swimming, aerobics, water aerobics and tai-chi. There are three full-time and one part-time staff who organize and manage physical activity programs on campus. The activities coordinator of the community rates the physical activity programs and facilities on campus as ‘good’, but not state of the art. The only physical activity participation data available is the log-in chart in the fitness room. In terms of decision making, most decisions are made entirely by staff or by the staff with some resident input. Campus security is an important issue at LV. Only a few building entrances – main entry to clubhouse, health center and residential buildings – are open to all residents and visitors all the time. All other entrances require a key card to enter from the outside. From the standpoint of walking, if residents decide to go for a walk along the trails and paths in the landscaped garden, they need to take their key card with them or they could get locked out and have to walk all the way around to the front to enter the building.

4.3 Case Study 3: PV retirement community

4.3.1 Physical Description

PV is a non-profit faith-based continuing care retirement community located in a suburb of Atlanta, Georgia. The campus was started in 1987, with buildings being slowly added to the campus over time. The wellness center was built in 2000. A dementia care unit under construction will be operational in early 2006. The campus is not directly connected to any recreational facilities outside the community. However, it is within easy driving distance to the Silver Comet Trail. The Silver Comet Trail is a 60 mile-long, converted rail-trail going from Smyrna, about 15 miles Northwest of Atlanta, Georgia to the Georgia-Alabama state line. There are several restaurants and department stores within a 5 minute driving distance of campus. There are no sidewalks on the main roads directly outside the campus. The campus is not gated and there is no security guard at the entrance.

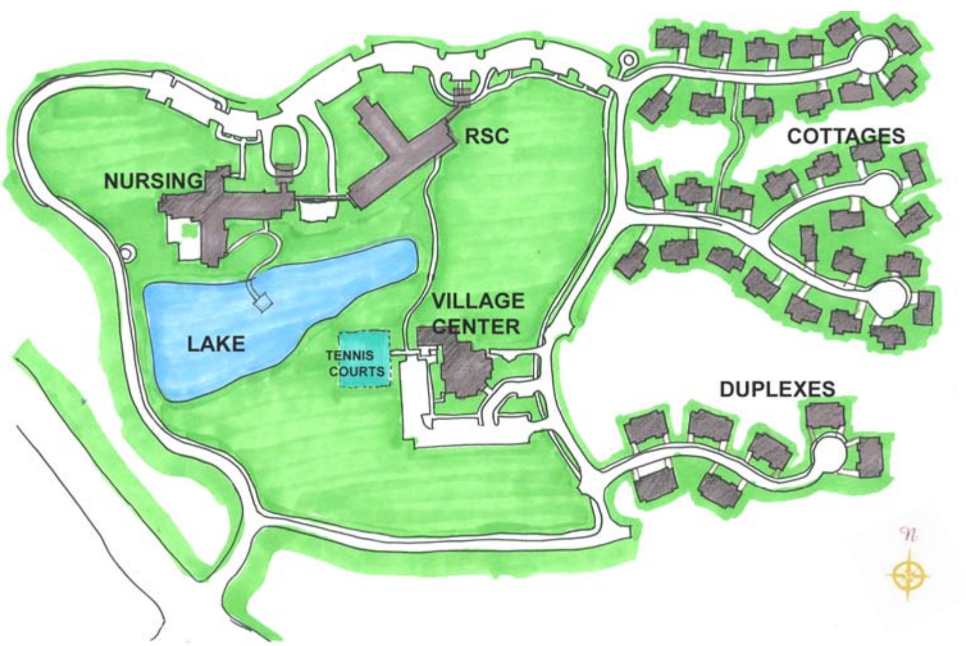


Figure 4.8: Campus plan of PV showing the resident apartment building (RSC), the nursing building, Village Center and Cottages.

PV is a medium sized CCRC at 60 acres. The campus has some gradual slopes and a few hills towards the east and south parts of the site. There are four main buildings on site (Figure 4.9). The resident services center or the RSC is a 4 story building with 49 independent living apartment units. The RSC is connected through a long corridor to the Health Services Center or the HSC, the skilled nursing care building (Figure 4.10a and Figure 4.10b). The fourth building is the Village center. This building is located at the center of the site, but it is not connected internally to any of the other buildings. There is an outdoor trail leading from the RSC to the wellness center. Other than these buildings, there are 55 cottages and cluster homes located on the eastern part of the site. A small lake is located on the site between the RSC and HSC buildings and the wellness center.

Figure 4.9a: Indoor connection between RSC and HSC on the second floor (left)

Figure 4.10b: View of the lake and Village Center from the covered connection between RSC and HSC (right)

A road runs along the perimeter of the campus connecting all the buildings and parking lots (Figure 4.9). Side streets off this main street provide access to the cottages/cluster homes. Outdoor features on campus include the lake, a gazebo in the lake, garden beds by the lake and a tennis court located near the wellness center. A walking path/sidewalk runs around campus parallel to the main street. The path is made of bitumen in most places.

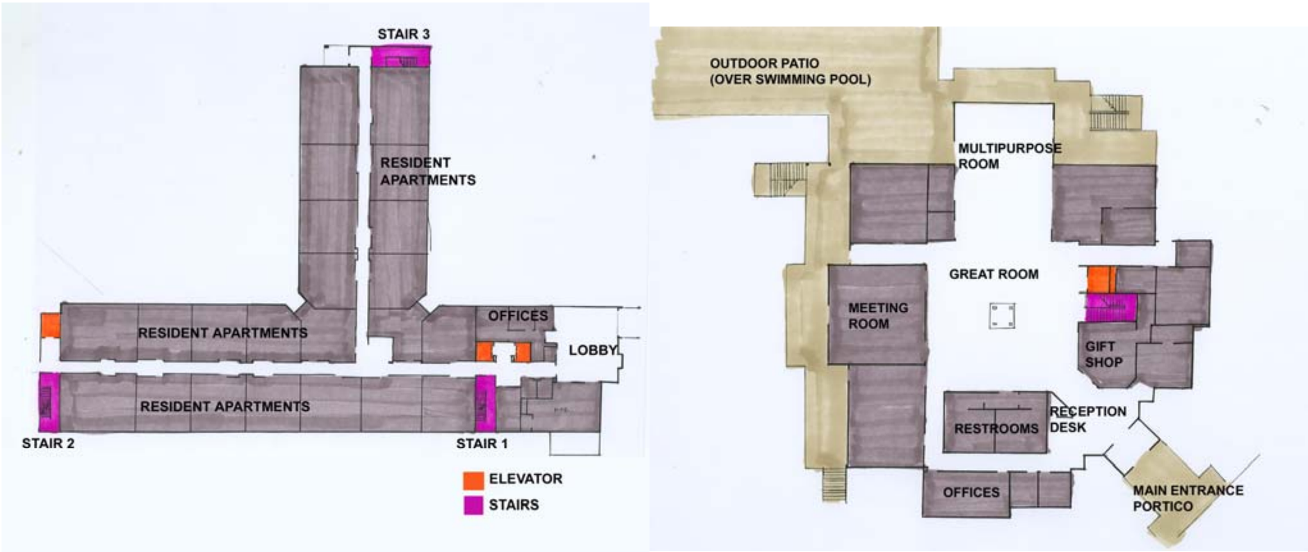


Figure 4.10: Buildings plans of the first floor of the RSC building (left) and main floor of the Village Center (right)

There are concrete sidewalks along the northern part of the site (by the residential buildings) and along the streets leading to the cottages/ cluster homes.

The main entrance to the RSC building is located on the first floor and it is directly accessed from parking areas along the main street. A lobby, reception areas, mailboxes for RSC residents and multipurpose activity room are located on this floor. The main dining room, administrative areas and some apartments are located one floor down (terrace level). Doors from the dining room open onto a path leading to the Village Center. The RSC building is T-shaped with resident apartments located on both sides of the corridors. The RSC building connects with the HSC building on the first floor and the second floor through long corridors. The corridors are climate controlled on both floors though the corridor on the first floor has vinyl flooring while the corridor on the second floor is carpeted. Residents have utilized the wider parts of the corridors to keep indoor plants. The first floor corridor enters the first floor of the HSC. The main floor of the HSC (administrative functions, main entrance lobby) is located one floor up. One floor down is the lowest floor of the HSC. The outdoor paths leading to the lake can be accessed from this floor.

The Village Center was designed to be the social and recreational hub of the community. The main entrance to the Village Center is on the second floor. This floor contains a central great room with meeting and activity spaces leading off it. Administrative offices, a gift shop, kitchen and activity rooms are located on this floor. All exercise/fitness related spaces are located on the lower floor of the Village Center. This includes an indoor heated swimming pool, exercise room with equipment and offices for trainers and activity coordinators. The path leading from the back of the RSC connects to the Village center at this level. According to residents and the activities coordinator, the village center is not used as much as it was intended. Some of the residents mentioned that the absence of a covered connection between the RSC building and the village center is one of the reasons people walk to it less often. Cottage residents who used the village center often drive down to it because of the steep slopes on that part of the site.

4.3.2 Resident characteristics

The minimum eligible age for residents to enter PV is 62 years. The median age of residents on campus is 83 years. There are 129 independent living residents on campus, 38% of who live in the apartment building, the remaining live in the cottages or cluster homes. Seventy two percent of the residents have lived on campus for over 3 years and 55% for over 5 years. Only 7% of the residents have been on campus for less than 6 months. Twenty-three percent of the residents use some type of assistive device to get around campus (12 residents use walkers, 8 residents use electric carts, 6 residents use canes and 4 use wheelchairs). Most residents are from middle to high income backgrounds and a majority resided in Georgia before they came to PV. About 70% of the residents on campus are female. There are some couples on campus and they reside in the cottages or the cluster homes.

4.3.3 Social environment

There is a resident association on campus which meets once a month. Also, the larger resident body is represented by a resident council made of 12 residents. There are several committees on campus that are involved with different aspects of resident life such as wellness, activities, landscaping, dining, hospitality, property management and spirituality. As many as 80% of the residents volunteer for campus activities (new resident orientation, reception etc.).

There is no formal walking club on campus. However, residents especially those residing in the cottages appeared to know the walking habits of their neighbors well and seemed to be aware of those residents who were particularly active.

4.3.4 Organizational environment:

PV is a Type C continuing care retirement community. This means that the type of contract it offers to residents is a fee-for-service where all services are on a pay-as-you-go basis at a rate specified by the provider. At PV, cottage and cluster homes pay an upfront entrance fee and monthly fee which covers many different services such as housekeeping, landscaping and so on. However, cottage and cluster residents are required to purchase a meal plan if they wish to have meals in the dining room in the RSC. RSC residents, on the other hand do not pay an upfront entrance fee, but do pay a monthly fee. Meals in the dining room are included as part of the monthly fee for RSC residents.

Promoting physical activity or wellness is not a stated mission of the facility. However, there seems to be a strong focus on promoting wellness and awareness of healthy practices among residents. An annual health fair on campus brings together health care providers, therapists, counselors and other individuals that provide information to residents about different aspects of their health. The facility has a wellness center with a heated indoor pool and exercise room with senior friendly equipment and trainer. Many different types of physical activity programs are offered on campus including swimming, aerobics, water aerobics, exercise classes and tai-chi. There are two full time and seven part-time staff members who organize and manage physical activity programs on campus. The activities coordinator of the community rates the physical activity programs and facilities on campus as excellent. Physical activity data available includes information collected from residents during the assessment phase and the wellness profile of residents who use the wellness center. The physical activity programs are offered in the RSC building as well as the Village Center. In addition to physical activity programs, residents have the opportunity to participate in as many as 10 social activities (discussion groups, classes, parties, religious services, arts and crafts, etc) one or more times a week.

In terms of decision making, most decisions are made entirely by staff or by the staff with some resident input. Residents primarily decide what kinds of new activities or programs will be offered on campus, though staff members provide some input.

4.4 Summary

The table below summarizes some of the key differences and similarities between the three facilities.

Table 4.1: Comparison of characteristics of three case study campuses

	PS	LV	PV
Year started	2004	2001	1987
Size of campus (acres)	54	87	60
Number of buildings on campus (excluding cottages)	5	4	4
Number of apartment buildings	3	2	1
Connection between all buildings?	Yes	Yes	No
Total number of path segments	258	275	103
Total number of IL residents	350	331	129
Median age of IL residents (years)	78	78	83
Number of survey respondents	38	40	36
Median age of survey respondents (years)	78	78	83

The three facilities selected for study are all continuing care retirement communities. That is, they provide three levels of care on the same campus. PS states clearly in its mission that promoting wellness among residents is a key goal. In the other communities this is not a stated mission, but appears to be an important goal based on discussion with administrators and residents. All communities have a wellness center on campus with a range of facilities including swimming pool, exercise rooms with equipment and other spaces for holding exercise classes. Also, all facilities offer a range of physical activity programs on campus. There is also an emphasis in all communities on providing a range of social and recreational activities to residents. All three communities have full time and part time staff members who organize and manage physical activity programs on campus. All three facilities have resident associations and resident councils that overlook aspects of resident life and provide input to staff. In PV and LV, residents actively volunteer on campus. PS has an active walking club organized by residents themselves. The other two communities do not have active walking clubs. In terms of organizational mission, policies and social environment, the three communities are quite similar.

The residents at the three communities are similar in terms of income levels (entrance fee and monthly fee is similar in all three communities) and ethnicity (predominantly white). The minimum eligible age for entering residents is 62 at PV and LV, and 60 at PS. PS and LV have younger residents (median age = 78) while the residents at PV are older (median age = 83). This is probably due to the fact that PV is an older campus and most residents who entered the campus at a younger age have stayed on (aged in place).

The case studies selected were intended to be as similar as possible in terms of physical characteristics such as age of campus, size of campus, terrain and layout of buildings on campus so that findings could be replicated across the cases. All three facilities are campus style retirement communities – they have many different buildings within the same boundary that are connected in some way.

All case studies have one or more resident apartment buildings and several cottages/cluster homes on campus. All campuses have a community center which forms a key focal point for the community. In all three communities the community center is a distinct building. In LV and PS the community center is physically connected to apartment buildings while in PV, the community center is a separate building.

Though all three campuses are relatively new (built in the last 20 years), PS and LV are newer than PV (PV is the oldest, having opened in 1987). However some parts of PV are also quite new. The campuses are all midsize (between 50 and 100 acres). However PV and PS are similar in size (60 acres and 54 acres), while LV is a larger campus at 87 acres, though a large part of the LV campus is very hilly and wooded and cannot be developed.

PS, LV and PV have many different types of walking paths on campus – indoor paths, covered connections between buildings, outdoors sidewalks, walking trails, street segments and transition paths into buildings. On the whole, the three communities are very well maintained and attractive. Indoor spaces are clean, well appointed and have attractive finishes. The ambience is homelike rather than institutional. Outdoor areas are well landscaped and have attractive elements such as water bodies, gazebos and gardens incorporated into the design. Walking paths are well maintained. Few paths in any of the communities have amenities such as benches or water fountains along them. The campuses have a range of gradients – from flat to gradually sloping to hilly. PS and LV have a larger number of path segments (>250), many of which are internal paths within buildings. PV has less number of paths.

The introduction to the physical characteristics of each campus and the social, organizational and demographic data is for comparative purposes. Each of the three communities provides many different types of environments for walking ranging from internal corridors between resident apartments to nature trails. This study is the first of its kind and few data are currently available about the types of environmental factors that may be related to where people walk in such types of settings. Similar settings were selected to see if findings were replicated. The detailed analysis of the case studies is presented in the following chapters.

CHAPTER 5

CASE STUDY 1: PS RETIREMENT COMMUNITY

5.1 Introduction

Chapters 5, 6 and 7 offer the quantitative, analytical description of path segments and path use for each of the three case studies. The data reported and analyzed in this chapter is derived from the path assessment conducted on each campus during site visits and from the information regarding route selection reported by residents in questionnaires.

Local, relational and global characteristics of path segments may influence where people choose to walk. Also, the environmental characteristics that influence path choice may differ depending on whether people are walking to get to destinations or whether they are walking for recreation/leisure. In this chapter, each of the environmental factors that may be related to path use is analyzed using statistical methods as well as graphical methods.

There are three main sections in each case study. The first section describes the characteristics of survey respondents and distribution of path segments on campus in terms of how often they were selected for recreational or instrumental walking. The second section begins to identify why certain types of path segments were chosen for walking while others were not. That is, what are the characteristics of path segments that tend to be chosen for walking for recreation or for getting to destinations versus those that are not? In this section, the local, relational and global path variables were analyzed statistically for their relationship with path use for recreation and for getting to destinations. In the third section, path segments and routes that were used highly for recreation are analyzed. In the first part of this section, the twenty path segments that were used most for recreation by different categories of residents were analyzed and patterns identified. While individual segment characteristics tell us something about why people may choose to walk there, it is also important to understand if there are certain characteristics of the overall route that people choose for walking for recreation that are important. The five most popular recreation routes on campus were identified and their characteristics are discussed. The findings from each case study are summarized at the end.

5.2 Survey respondent characteristics and path use characteristics

5.2.1 Survey Respondent Characteristics

Thirty-eight residents of the 350 residents at PS responded to the survey (11% response rate). The characteristics of the survey respondents were as follows:

Table 5.1: Characteristics of PS survey respondents

Respondent characteristics		**Overall**		**Male**		**Female**	
		N	%	N	%	N	%
Age	72 years or less 73-80 years 81 years and over	13 13 12	34 34 32	3 7 6	19 44 37	10 6 6	46 27 27
Gender	Male Female	16 22	42 58				
Type of residence	Apartment Cottage	29 9	76 24	13 3	81 19	16 6	73 27
Length of stay at community	Less than 6 months 6 months to one year One to three years Three to five years More than five years	5 33 0 0 0	13 87 0 0 0	2 14 0 0 0	13 87 0 0 0	3 19 0 0 0	14 86 0 0 0
Use assistive device for walking?	No Yes	35 3	92 8	14 2	87 13	21 1	95 5
Experienced health problems recently that affected walking	No Yes	29 9	76 24	13 3	81 19	16 6	73 27
Physical activity level (based on IPAQ)	Insufficiently active Sufficiently active Highly active Cases excluded	5 11 16 6	13 29 42 16	3 5 7 1	19 31 44 6	2 6 9 5	9 27 41 23

A majority of the respondents were below 80 years of age (68%). The median age of respondents was 78 and the average age was 77 years. There were more women in the sample (58%). Seventy six percent of the respondents lived in apartments in the villa buildings. Only eight percent of the respondents used assistive devices for walking. Twenty four percent of the sample reported that they had experienced health problems in the last 6 months that affected their walking. Forty two percent of the residents were classified as highly active while 13% were insufficiently active. Physical activity level could not be assessed for 16% of the respondents because they did not complete the IPAQ or the data was incomplete.

5.2.2 Path use characteristics

Path use for walking to destinations

Path use for walking to destinations was measured by how many times the path segment was selected by all respondents during two trips to two different destinations on campus in the last 7 days. A majority of the segments (59%) were not used at all by the respondents during the course of two trips taken to two different destinations in the last 7 days. Ninety percent of path segments were chosen 10 or fewer times. Only two percent of the path segments were used often (40 times or more) for walking to destinations at PS (Appendix B.1).

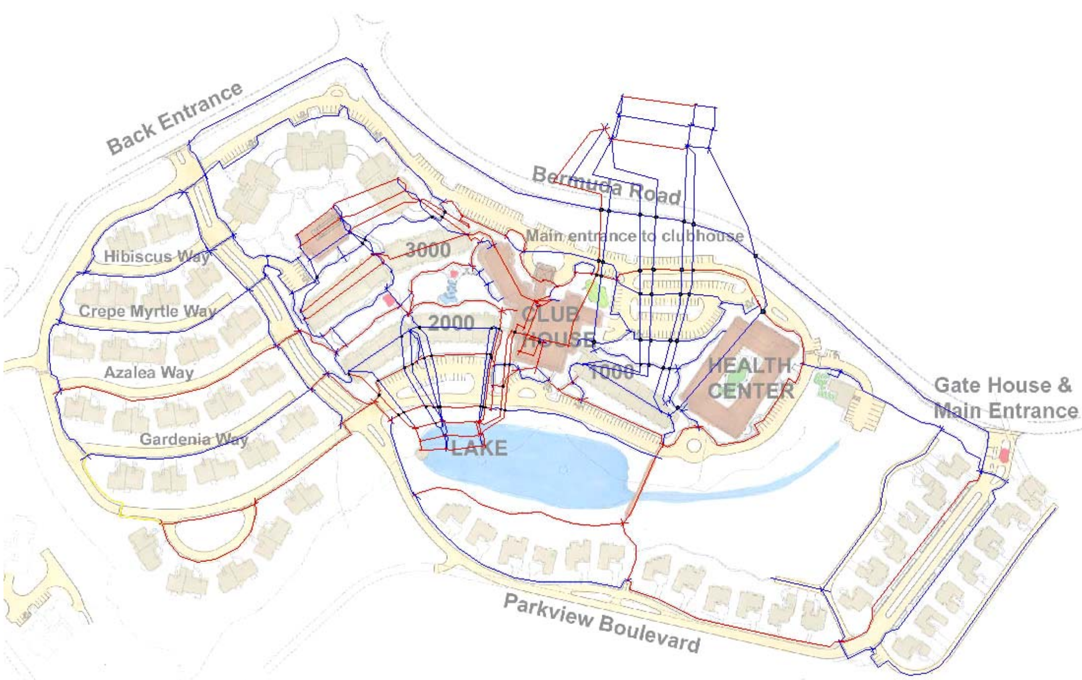


Figure 5.1: Path segments that were used (in red) and not used (in blue) for walking to destinations at PS

The site plan of PS (Figure 5.1) shows the distribution of path segments on the PS campus in terms of their use for walking to destinations. Many of the path segments that were used for walking to destinations were either path segments within the clubhouse building or path segments between resident apartments. The outdoor path segments (see figure 5.3) that were used for recreational walking were the ones leading from the cottages to the clubhouse.

Path use for walking for recreation

Path use for recreational walking was measured by the number of times the path segment was chosen by respondents during the course of their last recreational trip (indoor and outdoors) on campus in the last seven days. Thirty percent of the path segments were not used at all by any of the respondents. Forty percent of all path segments on campus were used 1-5 times. A very small percentage of the path segments (5%) were chosen very often (18 or more times) during recreational walking trips (Appendix B.2).

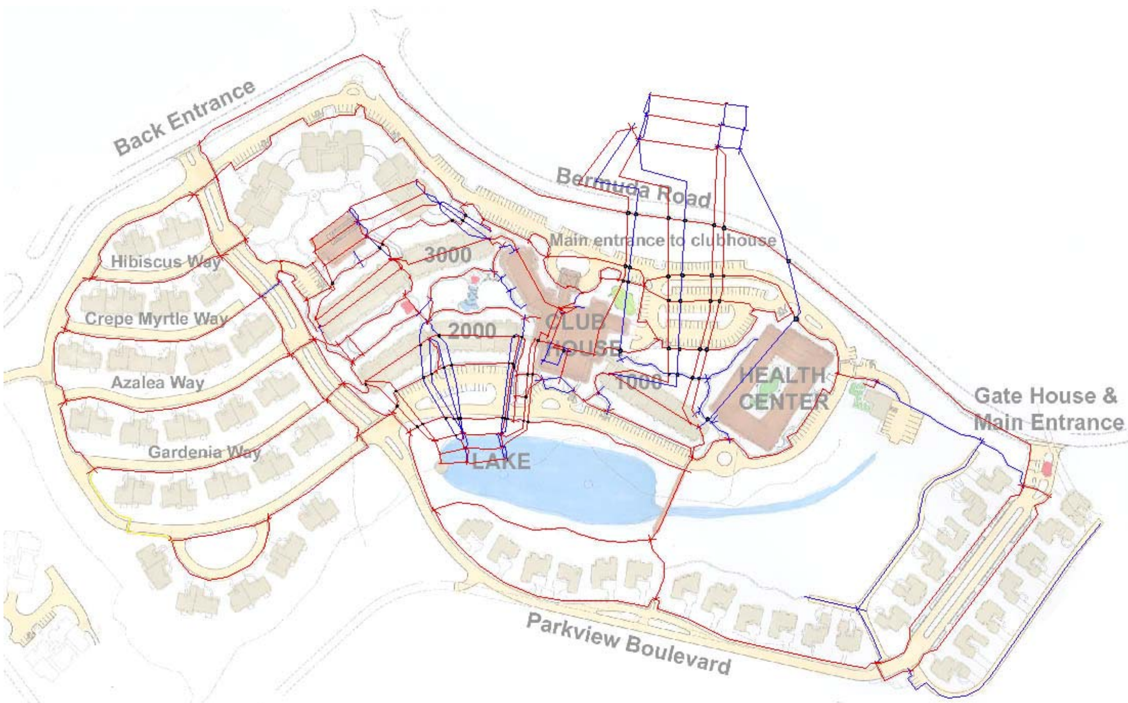


Figure 5.2: Path segments that were used (in red) and those that were not used (blue) for recreational walking at PS

The site plan of PS (Figure 5.2) shows which path segments on the PS campus were used for recreational walking (red) and path segments that were not used at all for recreational walking (blue). A majority of the path segments (71%) on the PS campus were used for walking for recreation (Appendix B.2). Seventy eight percent of the outdoor path segments were used for walking for recreation (for location of indoor and outdoor path segments see figure 5.3). Indoor path segments between residents apartments and in the clubhouse were also used. We see that several of the stair segments were not used at all.

Since the purpose of this study is to understand which aspects of path segments support their use for walking, it is useful to classify path segments into different categories based on use. This allows us to compare the characteristics of path segments in different use categories. For the most interpretable results path segments were classified into 2 categories – those that were not chosen at all for walking (no use) versus those that were chosen once or more for walking (to destinations or for recreation).

Table 5.2: Number and percentage of path segments that were used/ not used for getting to destinations and for recreation at PS by different categories of residents

Path use for ….		**Getting to destinations**				**Walking for recreation**			
		Path segments that were not used at all		**Path segments that had some use**		**Path segments that were not used at all**		**Path segments that had some use**	
		N	%	N	%	N	%	N	%
Overall (n=38)		152	59	106	41	76	29	182	71
Gender	Male (n=16)	213	83	45	17	128	49	130	51
	Female (n=22)	165	64	93	36	94	36	164	64
Use of assistive device?	Yes (n=3)	245	95	13	5	225	87	33	13
	No (n=35)	152	59	106	41	78	30	180	70
Reported health problems in the last six months that affected walking?	Yes (n=9)	213	83	45	17	165	64	93	36
	No (n=29)	164	64	94	36	80	31	178	69
Age	Below 72 (n=13)	177	69	81	31	110	43	148	57
	Between 73 and 80 (n=13)	217	84	41	16	119	46	139	54

Table 5.2: Number and percentage of path segments that were used/ not used for getting to destinations and for recreation at PS by different categories of residents

	81 and over (n=12)	214	83	44	17	174	67	84	33
Activity Category	Insufficiently active (n=5)	233	90	25	10	246	95	12	5
	Sufficiently active (n=11)	215	83	43	17	143	55	115	45
	Highly active (n=16)	185	72	73	18	105	41	153	59
Type of residence	Cottage (n=9)	197	76	61	24	148	57	110	43
	Apartment (n=29)	200	78	58	22	86	33	172	67

It is difficult to make comparisons within this table (Table 5.2) since the number of respondents in each category (e.g those using assistive devices versus those not using assistive devices) varies. The sample was almost equally divided in terms of age categories. We see that the youngest residents (those below 72 years) used 31% of all path segments for getting to destinations and 57% of all path segments for recreation. In comparison, the residents aged 73 to 80 and those aged 81 and higher used fewer path segments for walking to destination (16% and 17% respectively) and fewer path segments for recreational walking (54% and 33% respectively). Also, even though there were more apartment residents in the sample (n=29), we see that cottage residents tended to use a higher percentage of path segments for getting to destinations (24%) as compared to the apartment residents (22%). This may be related to the fact that cottage residents needed to walk across campus to get to the clubhouse building since all destinations were located within this building while apartment residents walked indoor routes to destinations within the clubhouse.

5.3 Environmental factors that may be related to path segment use

The environmental factors that are examined in this section include:

Local characteristics:

- Type of path segment – internal path or external path
- Length of path segment
- Location of path segment – for internal and external path segments
- Path material – internal and external path segments
- Path gradient
- Presence of street crossing in segment
- Presence of path obstruction
- Presence of steps
- Path continuity
- Number of amenities present
- Presence of destinations on path segment
- Number of destinations along path segment

Relational characteristics

- Presence of specific views from path segment
- Number of views from path segment

Global Characteristics

- Centrality of path segments on campus
- Number of routes the path segment lies on (choice)

The relationship of each of these path characteristics with path use for getting to destinations or path use for recreation was examined.

5.3.1 Local Path characteristics

5.3.1.1 Path Type

Outdoor path segments constituted 56.3% of all path segments on campus and indoor path segments made up the rest.

The site plan of PS (Figure 5.3) shows the indoor path segments (blue) and outdoor path segments (red). The indoor path segments were all connected to each other and were located in the center of the campus. Indoor path segments connected with outdoor path segments at many different points and at different levels (described in chapter 4).

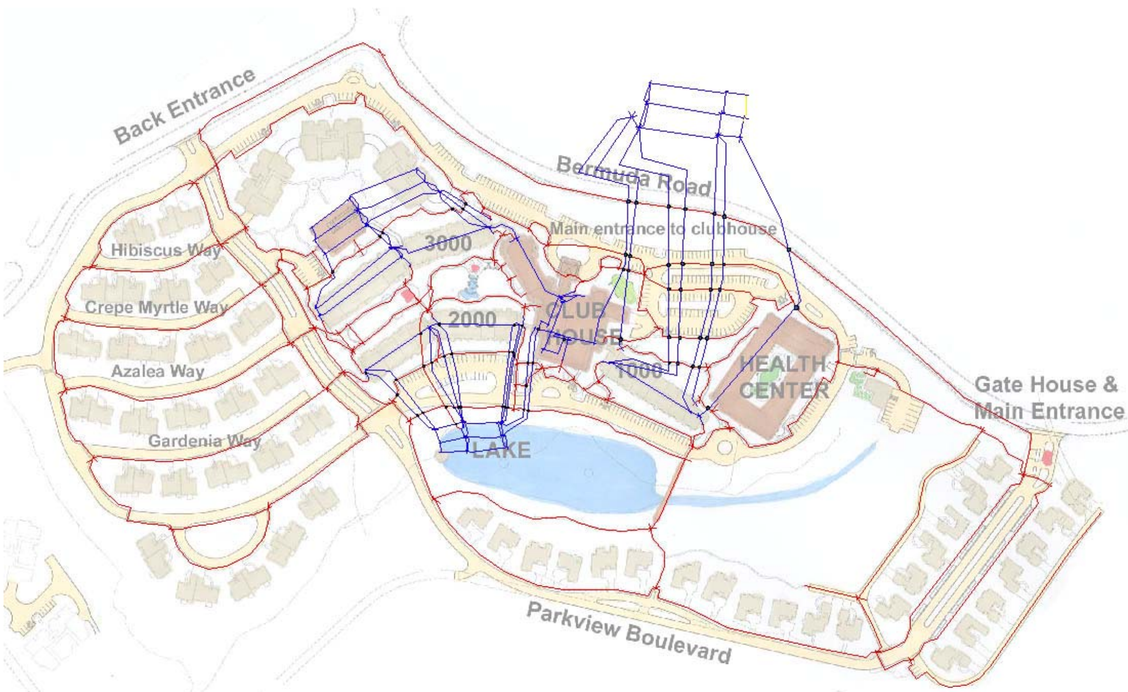


Figure 5.3: Outdoor (red) and indoor (blue) path segments on the PS campus

Research Question: Do indoor/outdoor path segments tend to be used differently for walking to destinations or for recreation

Path use for getting to destinations

Results: Overall, when all respondents are considered, there was no difference between indoor and outdoor path segments in terms of their use in getting to destinations ($p<0.05$). When specific categories of residents were considered some significant relationships were observed (Table 5.3). Male residents, residents using assistive devices, residents reporting health problems, residents not reporting health problems, residents between 73 to 80 years, residents over 81 years, insufficiently active residents, sufficiently active residents and apartment residents used a higher percentage of indoor path segments for walking to destinations. For example, residents reporting health problems used 26% of indoor path segments for getting to destinations while they only used 11% of outdoor path segments. There is no difference in use of indoor and outdoor path segments among female residents, those not using assistive devices, those below 72 years and highly active residents ($p>0.05$).

It is interesting to note that unlike all other categories of residents, cottage residents used outdoor path segments more often than indoor path segments while walking to destinations. This is related to the fact that the cottages are not physically connected to the clubhouse building, requiring cottage residents to use outdoor path segments.

Table 5.3: More indoor path segments were used over outdoor path segments for getting to destinations at PS

Segment use for getting to destinations by…	Use category	Indoor path segments	Outdoor path segments	Chi-square	p-value
Male	No use Some use	72% 28%	91% 9%	16.5	.000
Residents using assistive device	No use Some use	88% 12%	100% 0%	17.6	.000
Residents with health problems	No use Some use	74% 26%	89% 11%	9.4	.002
Residents with no health problems	No use Some use	56% 44%	70% 30%	5.3	.021
Residents aged 73 to 80 years	No use Some use	70% 30%	95% 5%	30.3	.000

Table 5.3: More indoor path segments were used over outdoor path segments for getting to destinations at PS

Residents 81 years or over	No use Some use	75% 25%	89% 11%	8.5	.004
Insufficiently active residents	No use Some use	85% 15%	94% 6%	6.6	.01
Sufficiently active residents	No use Some use	69% 31%	94% 6%	29.6	.000
Cottage residents	No use Some use	84% 16%	70% 30%	6.6	.01
Apartment residents	No use Some use	59% 41%	92% 8%	38.3	.000

Path use for walking for recreation

Results: Overall, more outdoor path segments were used for recreational walking as compared to indoor path segments. Almost 78% of all outdoor path segments at PS were chosen for recreational walking while only 61% of indoor path segments were chosen (Table 5.4). Also, a larger percentage of indoor path segments (39%) as compared to outdoor path segments (22%) were not used at all for recreational walking. When subcategories of residents are considered the same holds true – more outdoor path segments were preferred over indoor path segments for walking by most types of residents: male, female, with and without assistive devices, without health problems, highly active, below 72 years and apartment residents. There was no difference in use of indoor and outdoor path segments for recreation among residents reporting health problems, sufficiently active residents, residents aged between 73 to 80 years, residents over 81 years and cottage residents ($p>0.05$).

The only category of resident where the opposite relationship was observed in among insufficiently active residents: insufficiently active residents only used indoor path segments for recreation.

Table 5.4: Outdoor path segments were used over indoor path segments for recreational walking at PS

Segment use for walking for recreation by…	Use category	Indoor path segments	Outdoor path segments	Chi-square	p-value
Overall	No use Some use	39% 61%	22% 78%	8.7	.003
Male	No use Some use	61% 39%	41% 59%	10.5	.001
Female	No use Some use	43% 57%	31% 69%	4.1	.04
Residents using assistive device	No use Some use	96% 4%	81% 19%	12.6	.000
Residents not using any assistive device	No use Some use	40% 60%	23% 77%	8.8	.003
Residents with no health problems	No use Some use	42% 38%	23% 77%	10.5	.001
Residents aged below 72 years	No use Some use	53% 47%	35% 65%	8.9	.003
Insufficiently active residents	No use Some use	89% 11%	100% 0%	16.1	.000
Highly active residents	No use Some use	52% 48%	32% 68%	11.0	.001
Apartment residents	No use Some use	42% 58%	27% 73%	6.2	.013

5.3.1.2 Length of Path Segment

Forty two percent of all path segments on campus were less than 50 feet. Less than 6% of the path segments were over 451 feet (Table 5.5).

Table 5.5: Distribution of path segments on PS by length of segment

Length of path segment		Number of path	Percent	Cumulative Percent
	less than 50'	107	41.8	41.8
	51' to 100'	60	23.4	65.2
	101' to 150'	21	8.2	73.4
	151' to 200'	18	7.0	80.5
	201' to 250'	24	9.4	89.8
	251' to 300'	4	1.6	91.4
	301' to 350'	4	1.6	93.0
	351' to 400'	4	1.6	94.5
	401' to 450'	1	.4	94.9
	451' to 500'	5	2.0	96.9
	over 501'	8	3.1	100.0
	Total	256	100.0	
Missing	System	2		
Total		258		

For the purpose of analysis path segments were classified as short (less than 50 feet) (41.8% of all path segments) and not short (51 feet or over) (59.2%).

The site plan of PS (Figure 5.4) shows where short (blue) and long (red) path segments are located on campus. Seventy seven percent of the outdoor path segments at PS are long segments. Many indoor segments (59%), especially segments connecting different levels (stairs) were short. Sixty six percent of the indoor path segments between resident apartments were long segments (more than 51 feet in length).

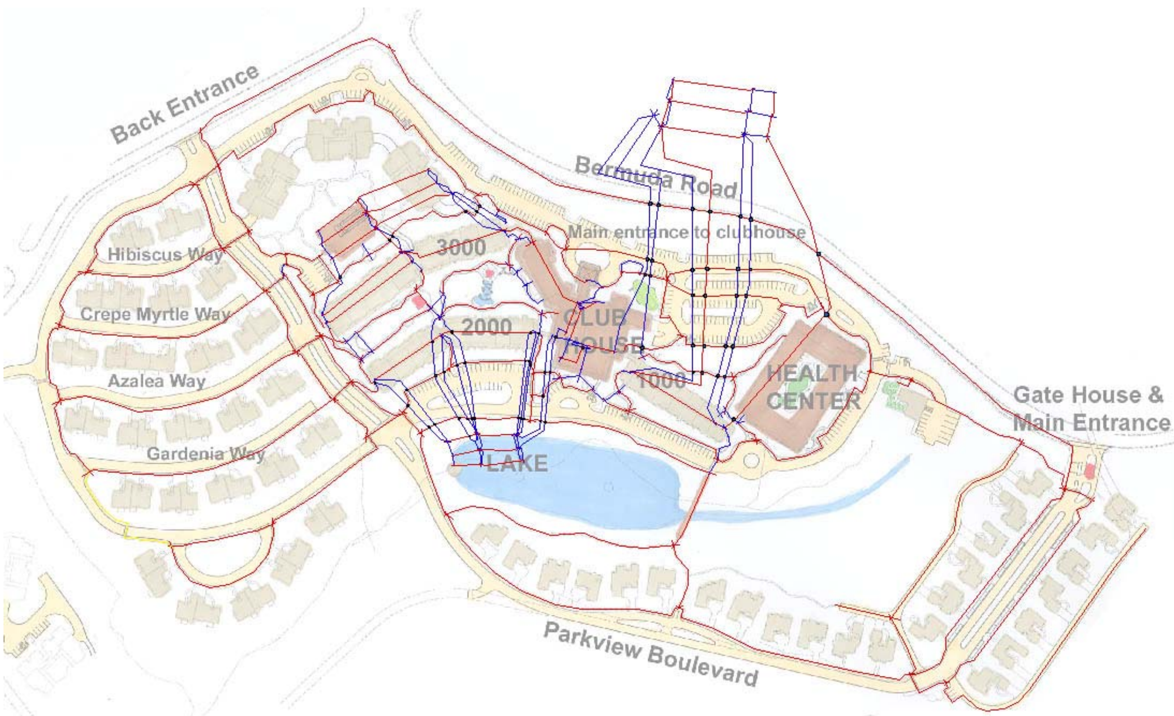


Figure 5.4: Long (in red) and short (in blue) path segments on the PS campus

Research Question: Is the length of a path segment related to its being chosen for getting to destinations or for recreation?

Path use for getting to destinations

Results: The length of the segment was not related to its use for walking to destinations. That is, shorter path segments were no more likely than longer path segments to be used for walking to destinations (p= 0.725). This was true even when all resident level outcome variables were considered (p> 0.6 for 8 resident categories and between 0.2 and 0.5 for the other six resident categories).

Path use for recreational walking

Results: The length of the segment was related to path use for walking for recreation. A higher percentage of longer path segments were chosen over shorter path segments for walking for recreation (p=0.000). The table below (Table 5.6) shows the relationship between path use and path length for all residents and all subcategories of residents. Overall, around 83% of all long path segments on campus were chosen for walking to destinations, while only 53% of short path segments were chosen.

This is true when all residents were considered and also when all subcategories of residents were considered. The only exception was path use by insufficiently active residents – there was no difference in use between short and long path segments (p= 0.98).

Table 5.6: More long segments were used for recreational walking at PS

Segment use for walking for recreation by…	Use category	Short path segments	Long path segments	Chi-square	P-value
Overall	No use Some use	47% 53%	17% 83%	28.2	.000
Male	No use Some use	77% 23%	30% 70%	55.1	.000
Female	No use Some use	52% 48%	25% 75%	19.1	.000
Residents using assistive device	No use Some use	95% 5%	81% 19%	11.	.001
Residents not using any assistive device	No use Some use	48% 52%	17% 83%	28.3	.000

Table 5.6: More long segments were used for recreational walking at PS

Residents with health problems	No use Some use	79% 21%	53% 47%	17.5	.000
Residents with no health problems	No use Some use	60% 40%	17% 83%	34.4	.000
Residents aged below 72 years	No use Some use	66% 34%	26% 74%	40.5	.000
Residents between 73 to 80 years	No use Some use	63% 37%	34% 66%	21.2	.000
Residents 81 years and over	No use Some use	82% 18%	57% 43%	16.7	.000
Sufficiently active residents	No use Some use	78% 22%	39% 61%	37.5	.000
Highly active residents	No use Some use	64% 36%	24% 76%	41.4	.000
Cottage residents	No use Some use	81% 19%	41% 59%	40.8	.000
Apartment residents	No use Some use	50% 50%	21% 79%	23.2	.000

5.3.1.3 Location of indoor path segments

Indoor path segments were categorized as:

1. Path segments between resident apartments
2. Path segments through public spaces
3. Connections between buildings
4. Internal staircases

Table 5.7: Distribution of indoor path segments by location

Location of internal path segments segments	Number of path segments	Percent
Path between resident apartments	32	28.3
Path through public spaces	47	41.6
Connection between buildings	5	4.4
stair	29	25.7
Total	113	100.0

Analysis of path use among these four types of indoor path segments suggested that the difference in path use was between path segments between resident apartment and other types of indoor path segments. For the purpose of analysis, path segments were organized into two categories – between resident apartments and other types of indoor path segments.

Research Question: Are different types of indoor path segments (located in different places) used differently for walking for recreation/ getting to destinations?

Path use for getting to destinations

Results: The location of indoor path segments matters. Sixty six percent of the internal path segments that were located between resident apartments were chosen for getting to destinations, while only 38% of other indoor path segments were chosen for getting to destinations (Table 5.8). This relationship was significant for path use by female residents, those who did not use any assistive device, those without any health problems, those between 73 and 80 years and apartment residents. There was no difference in path use based on location of indoor path segments for other categories of residents. The only exception was cottage residents. Cottage residents did not use any path segments between resident apartments while walking to destinations – they only used other types of indoor path segments.

Table 5.8: More path segments between resident apartments were used compared to other indoor path segments

Segment use for getting to destinations by…	Use category	Path segments between resident apartments	Other internal path segments	Chi-square	p-value
Overall	No use Some use	34% 66%	62% 38%	6.9	.009
Female	No use Some use	44% 56%	67% 33%	5.0	.025
Residents not using any assistive device	No use Some use	34% 66%	62% 38%	6.9	.009
Residents with no health problems	No use Some use	38% 62%	63% 37%	6.0	.014
Residents between 73 to 80 years	No use Some use	53% 47%	77% 23%	5.9	.014
Cottage residents	No use Some use	100% 0%	78% 22%	8.5	.004
Apartment residents	No use Some use	34% 66%	69% 31%	11.5	.001

Path use for walking for recreation

Results: The location of indoor path segments appears to be related to walking for recreation. A high percentage of the path segments located between resident apartments (81%) were used for walking for recreation while only 53% of all other indoor path segments were used for walking for recreation (Table 5.9). This was found to be true for all categories of residents. The relationship was not significant for path use by residents using assistive devices (p= .55) and path use by insufficiently active residents (p=.78).

Table 5.9: More path segments between resident apartments were used for recreational walking as compared to other indoor path segments

Segment use for walking for recreation by…	Use category	Path segments between resident apartments	Other indoor path segments	Chi-square	p-value
Overall	No use Some use	19% 81%	47% 53%	7.6	.006
Male	No use Some use	28% 72%	74% 26%	20.4	.000
Female	No use Some use	22% 78%	52% 48%	8.4	.004
Residents not using any assistive device	No use Some use	22% 78%	47% 53%	6.0	.014
Residents with health problems	No use Some use	53% 47%	77% 23%	5.9	.014
Residents with no health problems	No use Some use	22% 78%	49% 51%	7.1	.008
Residents aged below 72 years	No use Some use	31% 69%	62% 38%	8.5	.003
Residents between 73 to 80 years	No use Some use	25% 75%	63% 27%	13.2	.000
Residents 81 years and over	No use Some use	41% 39%	80% 20%	16.8	.000
Sufficiently active residents	No use Some use	31% 69%	73% 27%	16.7	.000
Highly active residents	No use Some use	28% 72%	62% 38%	10.4	.001
Cottage residents	No use Some use	38% 62%	74% 26%	13.3	.000
Apartment residents	No use Some use	22% 78%	49% 51%	7.1	.008

5.3.1.4 Location of outdoor path segments

Six main categories of outdoor path segments on campus were:

1. Sidewalk next to road
2. Sidewalk within 1m of curb
3. Shared path no markings
4. Path trail through park
5. Access lane
6. Road crossover

Sidewalks and path segments/trails though parks are the two main types of outdoor path segments on campus (Table 5.10). When the six types of path segments were compared, the main difference in use was observed between sidewalk path segments and other types of path segments. Thus, outdoor path segments were classified into two main categories – sidewalk segments (sidewalk next to road + sidewalk within 1 m of kerb) and all other types of outdoor path segments.

Table 5.10: Distribution of outdoor path segments at PS based on location of segment

Location of outdoor path segment	Number of path segments	Percentage
Sidewalk next to road	62	43.1
Sidewalk within 1m of kerb	1	.7
Shared path, no markings	9	6.3
Path/trail through park	45	31.3
Access lane	15	10.4
road crossover	12	8.3
Total	144	100.0

Research Question: Is the location of outdoor path segments related to their use for walking for recreation/ getting to destinations?

Path use for getting to destinations:

Results: Sidewalk segments were used no differently from other types of outdoor path segments while walking to destinations on campus (p= 0.5). This was true even when path use by different categories of residents was considered (p between 0.1 and 0.8 for all resident categories).

Path use for recreational walking

Results: More sidewalk segments (98%) were used for walking for recreation as compared to all other types of outdoor path segments (63%). This was true when path use by all respondents was considered and when path use by different categories of residents was considered (Table 5.12). Insufficiently active residents did not use outdoor path segments at all for recreational walking. Residents who did not use assistive devices and residents who did not report any health problems also used many of the other types of outdoor path segments (around 63%), though they tended to use more of the sidewalk segments (around 97%) (Table 5.11).

Table 5.11: More sidewalk segments were used for walking for recreation at PS.

Segment use for walking for recreation by…	Use category	Sidewalk segments	All other outdoor path segments	Chi-square	p-value
Overall	No use Some use	2% 98%	37% 63%	26.4	.000
Male	No use Some use	18% 82%	58% 42%	24.2	.000
Female	No use Some use	10% 90%	47% 53%	23.2	.000
Residents using assistive devices	No use Some use	68% 32%	90% 10%	10.8	.001
Residents not using any assistive device	No use Some use	3% 97%	37% 63%	23.5	.000
Residents with health problems	No use Some use	37% 63%	77% 23%	23.5	.000
Residents with no health problems	No use Some use	2% 98%	38% 62%	27.6	.000
Residents aged below 72 years	No use Some use	5% 95%	57% 43%	42.3	.000
Residents between 73 to 80 years	No use Some use	22% 78%	56% 44%	16.3	.000
Residents 81 years and over	No use Some use	52% 48%	77% 23%	9.2	.002

Table 5.11: More sidewalk segments were used for walking for recreation at PS.

Sufficiently active residents	No use Some use	24% 76%	72% 28%	32.4	.000
Highly active residents	No use Some use	10% 90%	48% 52%	24.6	.000
Cottage residents	No use Some use	21% 79%	77% 23%	44.4	.000
Apartment residents	No use Some use	6% 94%	42% 58%	23.2	.000

5.3.1.5 Path Material – Outdoor path segments

Eighty three percent of the outdoor path segments on campus are made of continuous concrete. A small number of path segments (8.3%) are made of paving bricks (road crossovers) and bitumen (street segments without sidewalks) (6.3%). Two segments (1.4%) are made of wood planks (the bridge over the lake).

Research Question: Is the material of which outdoor path segments are constructed related to their use for walking to destinations/walking for recreation?

Results: Path material of outdoor path segments was not related to their use for walking to destinations (p=0.66) or their use for walking for recreation (p= 0.06). This was true even when path use by all categories of residents was taken into consideration (p between 0.079 and 0.9).

5.3.1.6 Path Material – Indoor path segments

Seventy percent of all indoor path segments were carpeted. Twenty five percent of the indoor path segments were made of concrete and five percent of stone. None of the indoor path segments had vinyl or tile flooring surfaces.

Research Question: Is the material of which indoor path segments are constructed related to their use for walking to destinations/walking for recreation?

Results: Path material of indoor path segments was not related to their use for walking to destinations (p=0.7) or their use for walking for recreation at PS (p= 0.78). This is true even when path use by all categories of residents was taken into consideration.

5.3.1.7 Path gradient

Since indoor path segments were flat (no variation), only outdoor path segments were considered for the analysis. Around 74% of all outdoor path segments at PS were flat, 21% had moderate slope and very few outdoor path segments (5%) were steep.
Research Question: Is path gradient related to use of path segments for walking for recreation/ getting to destinations?

Results: Path gradient was not related to use of path segments for walking to get to destinations at PS (p=0.52) or for walking for recreation (p= 0.2). This was true even when path use by subcategories of residents was considered (path use for walking to destinations p>0.5 for 9 resident categories and 0.5>p>0.2 for others). Path use for recreational walking was not related to path gradient for most resident categories (p>0.2 for 9 categories and p>0.05 for 3 categories). For residents aged 73 to 80 (p= 0.024) and residents that are highly active (p=0.012) the relationship was significant, but it was not clear where the difference in use lay (between flat, moderately sloping or steep path segments).

5.3.1.8 Path condition

Ninety five percent of all path segments at PS were in good condition. Since there was insufficient variation, this variable was excluded from the analysis.

5.3.1.9 Presence of street crossing in segment

A very small proportion of all path segments on campus had street crossings in them (11%).

Research Question: Is the presence of a street crossing within the segment related to its use for walking for recreation/ getting to destinations?

Results:

Path use for walking to destinations

The presence of a street crossing within a path segment was not related to use of path segments for walking to destinations at PS (p=0.8). This was true even when path use by subcategories of residents was considered (p>0.05).

Path use for recreational walking

A higher percentage of path segments with street crossings in them (93%) were used for recreational walking as compared to path segments without street crossings (68%) (Table 5.12). This was also true for path use for recreation by most categories of residents. This is not significant for female residents, residents using assistive devices, residents with health problems and insufficiently active residents.

Table 5.12: A higher percentage of path segments with street crossings were used for recreational walking

Segment use for walking for recreation by…	Use category	Path segments without street crossings	Path segments with street crossings	Chi square	p-value
Overall	No use Some use	32 68	7 93	7.5	.006
Male	No use Some use	54 46	18 82	12.6	.000
Residents not using any assistive device	No use Some use	33 67	7 93	7.9	.005
Residents with no health problems	No use Some use	34 66	7 93	8.3	.004
Residents aged below 72 years	No use Some use	47 53	11 89	13.1	.000
Residents between 73 to 80 years	No use Some use	49 51	21 79	7.7	.005
Residents 81 years and over	No use Some use	70 30	50 50	4.3	.035
Sufficiently	No use	58	36	4.9	.026

Table 5.12: A higher percentage of path segments with street crossings were used for recreational walking

active residents	Some use	42	54		
Highly active residents	No use Some use	45 55	7 93	14.6	.000
Cottage residents	No use Some use	61 39	29 71	10.6	.001
Apartment residents	No use Some use	36 64	11 89	7.2	.007

5.3.1.10 Presence of path obstructions in segment

Only 8% of all path segments had some type of obstruction present.

Research Question: Is the presence of an obstruction within the segment related to its use for walking for recreation/ getting to destinations?

Results: The presence of an obstruction within a path segment was not related to use of path segments for walking for recreation (p=0.27) or walking to get to destinations at PS (p=0.09). This was true even when path use by subcategories of residents was considered (p value between 0.27 and 1.0 for recreational path use by resident categories and between 0.09 and 0.4 for path use for instrumental walking).

5.3.1.11 Presence of steps in the segment

Very few path segments on campus had steps (14%). Most of these are stair segments inside the residential villa buildings or the clubhouse (Figure 5.5). There are two outdoor path segments which have many steps in them: the segment connecting the cottages on Parkview Boulevard to the bridge across the lake and the path segment in the landscaped courtyard between 2000 and 3000 villa buildings.

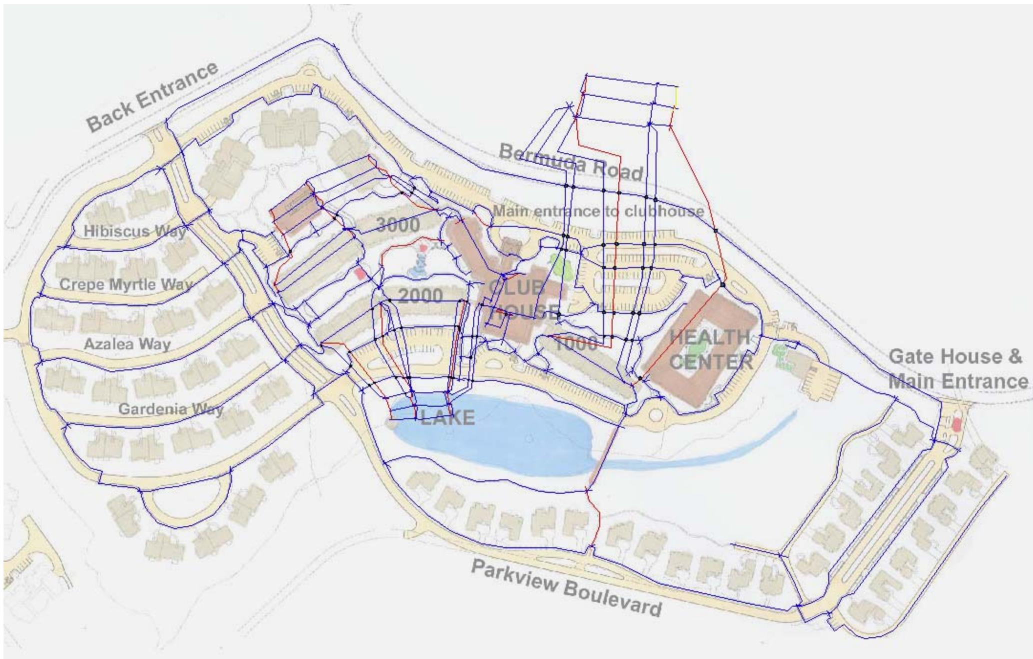


Figure 5.5: Fourteen percent of all path segments at PS have steps in them (red)

Research Question: Is the presence of steps within a segment related to its use for walking for recreation/ getting to destinations?

Path use for getting to destinations

Results: The presence of steps within a segment was related to its use for walking to destinations, though the relationship was marginally significant (p=0.047). Forty three percent of the path segments without steps were used for getting to destinations while only 26% of the path segments with steps were used (Table 5.13). The relationship holds true for path use by male residents, residents not using any assistive devices and residents not reporting any health problems. The relationship was not significant for other resident categories (p> 0.1 for 9 categories and between 0.05 and 0.1 for 2 categories)

Table 5.13: More path segments without steps were used for walking to destinations at PS

Segment use for getting to destinations by…	Use category	Path segments without steps	Path segments with steps	Chi-square	p-value
Overall	No use Some use	57% 43%	74% 26%	3.9	.047
Male	No use Some use	81% 19%	94% 6%	3.9	.049
Residents not using any assistive device	No use Some use	57% 43%	74% 26%	3.9	.047
Residents with no health problems	No use Some use	61% 39%	80% 20%	4.7	.03

<u>Path use for recreational walking</u>

Results: The presence of steps within a path segment was related to its use for walking for recreation. A higher percentage of path segments without steps were used for recreational walking as compared to path segments with steps (Table 5.14). This was also true when path use by different categories of residents was considered. There was no difference in path use between path segments with and without steps by residents using assistive devices, insufficiently active residents and apartment residents ($p>0.05$).

Table 5.14: More path segments without steps were used for walking for recreation at PS

Segment use for walking for recreation by…	Use category	Path segments without steps	Path segments with steps	Chi-square	p-value
Overall	No use Some use	27% 73%	46% 54%	5.2	.023
Male	No use Some use	45% 55%	77% 23%	12.3	.000
Female	No use Some use	34% 66%	51% 49%	3.9	.047
Residents not using any assistive device	No use Some use	28% 78%	46% 54%	4.6	.032
Residents with health problems	No use Some use	61% 39%	86% 14%	8.3	.004
Residents with no health problems	No use Some use	29% 71%	46% 54%	4.1	.043
Residents aged below 72 years	No use Some use	39% 61%	69% 31%	11.1	.001
Residents	No use	43%	66%	6.3	.012

Table 5.14: More path segments without steps were used for walking for recreation at PS

between 73 to 80 years	Some use	57%	34%		
Residents 81 years and over	No use Some use	65% 35%	83% 17%	4.4	.036
Sufficiently active residents	No use Some use	51% 49%	86% 14%	15.0	.000
Highly active residents	No use Some use	37% 63%	63% 37%	8.2	.004
Cottage residents	No use Some use	53% 47%	83% 17%	10.7	.001

5.3.1.12 Path Continuity

A majority of the path segments on campus (88%) formed direct and useful routes. Relatively few path segments were disjointed. Most of the disjointed path segments were outdoor path segments that were either incomplete (the connection to other path segments has not been built) or were not easily incorporated within a continuous walking route (i.e. did not lead to any kind of destination) (Figure 5.6).

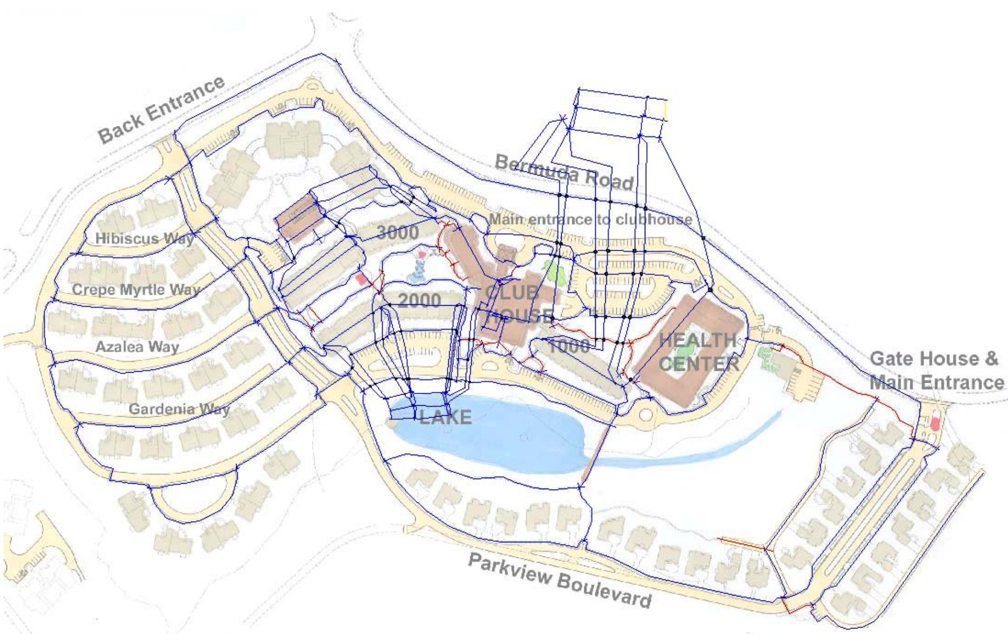


Figure 5.6: PS site plan with overlay of path segments that are disjointed (red) and continuous (blue)

Research Question: Are more continuous path segments chosen for walking for recreation/getting to destinations as compared to disjointed path segments?

<u>*Path use for walking to destinations*</u>

Results: Continuous path segments were preferred over disjointed path segments for walking to destinations. Forty four percent of continuous path segments were chosen for walking to destinations while only 19% of all disjointed path segments were chosen (Table 5.15). This relationship held true even when path use by different categories of residents was considered. Path continuity was not related to path use for walking to destinations by residents using assistive devices, residents with health problems, insufficiently active residents, residents between 73 and 80 years, cottage residents and apartment residents.

Table 5.15: More continuous path segments were used for walking to destinations as compared to disjointed path segments

Segment use for getting to destinations by…	Use category	Continuous path segments	Disjointed path segments	Chi-square	p-value
Overall	No use Some use	56% 44%	81% 19%	6.8	.009
Male	No use Some use	81% 19%	97% 3%	4.9	.026
Female	No use Some use	62% 38%	81% 19%	4.3	.039
Residents not using any assistive device	No use Some use	56% 44%	81% 19%	6.8	.009
Residents with no health problems	No use Some use	60% 40%	87% 13%	8.4	.004
Residents aged below 72 years	No use Some use	66% 34%	90% 10%	7.7	.005
Residents 81 years and over	No use Some use	81% 19%	97% 3%	4.7	.029
Sufficiently active residents	No use Some use	82% 18%	97% 3%	4.6	.032
Highly active residents	No use Some use	69% 31%	90% 10%	6.0	.014

Path use for recreational walking

Results: More continuous path segments were used for walking for recreation as compared to disjointed path segments. Seventy six percent of all continuous path segments were used for recreational walking while only 32% of disjointed path segments were used (Table 5.16). A higher percentage of continuous path segments were used for recreational walking even when different resident categories were considered. Path continuity is not related to path use by residents using assistive devices and insufficiently active residents ($p>0.05$).

Table 5.16: More continuous path segments were used for recreation as compared to disjointed path segments

Segment use for walking for recreation by…	Use category	Continuous path segments	Disjointed path segments	Chi-square	p-value
Overall	No use Some use	24% 76%	68% 32%	24.8	.000
Male	No use Some use	45% 55%	87% 13%	19.8	.000
Female	No use Some use	32% 78%	71% 29%	18.1	.000
Residents not using any assistive device	No use Some use	25% 75%	68% 32%	23.5	.000
Residents with health problems	No use Some use	60% 40%	90% 10%	10.6	.001
Residents with no health problems	No use Some use	26% 74%	68% 32%	22.2	.000
Residents aged below 72 years	No use Some use	37% 63%	87% 13%	28.5	.000
Residents between 73 to 80 years	No use Some use	42% 58%	77% 23%	13.9	.000
Residents 81 years and over	No use Some use	64% 36%	94% 6%	10.9	.001
Sufficiently active residents	No use Some use	51% 49%	90% 10%	17.4	.000
Highly active residents	No use Some use	37% 63%	71% 29%	13.4	.000
Cottage residents	No use Some use	52% 48%	97% 3%	22.4	.000
Apartment residents	No use Some use	29% 71%	68% 32%	18.8	.000

5.3.1.13 Number of amenities present

Fifty five percent of path segments on the PS campus had no amenities (benches, water fountains, handrails) along them. The rest had one or more amenities along them. As can be seen from the plan (Figure 5.7), 87% of the indoor path segments and only 13% of the outdoor path segments had one or more amenities along them. The outdoor path segments that had amenities along them are the ones circling the lake in the landscaped courtyard between buildings 3000 and 2000. There are a few benches located on the path segments around the lake.

Figure 5.7: PS site plan with overlay of path segments with amenities (red), no amenities (blue)

Research question: Is the presence of one or more amenities on a path segment related to its use for walking for recreation/getting to destinations?

Path use for getting to destinations

Results: Presence of amenities on the path segment was not related to its use for walking to destinations (p=0.13). This was true even when path use by categories of residents was considered (p between 0.13 and 0.9).

Path use for walking for recreation

Results: There is a relationship between the presence of amenities and use of path segments for walking for recreation. However, the result is contrary to expectation. A higher percentage of path segments *without* amenities were used for recreation as compared to the percentage of path segments with amenities (Table 5.17). This pattern holds true even for path use by different categories of residents. It is possible that this relationship turned out to be significant because most of the path segments without amenities are outdoor path segments (89%), most of which were used for recreational walking.

Table 5.17: More path segments without amenities were used for recreational walking

Segment use for walking for recreation by…	Use category	Path segments with no amenities	Path segments with one or more amenities	Chi-square	p-value
Overall	No use Some use	24% 76%	36% 64%	4.3	.039
Male	No use Some use	43% 57%	58% 42%	6.2	.013
Female	No use Some use	31% 69%	44% 56%	4.7	.03
Residents not using any assistive device	No use Some use	25% 75%	37% 63%	4.3	.038
Residents with health problems	No use Some use	58% 42%	71% 29%	4.5	.033
Residents with no health problems	No use Some use	25% 75%	39% 61%	5.5	.012
Residents aged below 72 years	No use Some use	33% 67%	55% 45%	12.7	.000
Residents between 73 to 80 years	No use Some use	40% 60%	53% 47%	4.1	.044
Highly active residents	No use Some use	32% 68%	51% 49%	9.9	.002
Cottage residents	No use Some use	50% 50%	66% 34%	6.2	.012

5.3.1.14 Presence of specific destinations on path

Residential areas were located along 24% of the path segments on the PS campus, parking areas on 14% of the path segments and activity related areas on 9%. Natural features were found on 5% of path segments on PS. Other destinations such as shops, chapel, beauty salon and admin areas were found along fewer that 5% of the path segments and were thus excluded from the analysis (Table 5.18).

Table 5.18: Types of destinations along path segments at PS

Type of Destination	Number of path segments with destination	%
Residential	64	24
Shops	8	3
Activity related areas	25	9
Chapel	0	0
Beauty salon/bank	2	1
Admin areas	11	4
Natural features	14	5
Parking	38	14

Figure 5.8: PS site plan with overlay of path segments with residential destinations (red)

Figure 5.9: PS site plan with overlay of path segments with activity related destinations (red)

Figure 5.10: PS site plan with overlay of path segments with parking destinations along them (red)

Figure 5.11: PS site plan with overlay of path segments with natural destination on them (red)

<u>Path use for walking to destinations</u>

Residential areas

Path segments with residential areas were used no differently from other types of path segments while walking to destinations (p=.095). This was also true for path use by all different categories of residents (p>=0.095) except apartment residents (p=0.022). Apartment residents used 32% of path segments with residential destinations and 19% of path segments without destinations.

Activity-related areas

A higher percentage of path segments with activity related areas (64%) were used for walking to destinations as compared to path segments with no activity related areas (39%). The relationship between the presence of activity related destinations and path use for walking to destinations was true for all categories of residents as well (Table 5.19).

Table 5.19: More path segments with activity-related destinations along them were used for walking to destinations at PS

Segment use for getting to destinations by…	Use category	Path segment with no activity related areas	Path segment with activity related areas	Chi-square	p-value
Overall	No use Some use	61% 39%	36% 64%	6.0	.014
Male	No use Some use	85% 15%	60% 40%	9.8	.002
Female	No use Some use	67% 33%	36% 64%	9.4	.002
Residents using assistive devices	No use Some use	97% 3%	80% 20%	12.9	.000
Residents not using any assistive device	No use Some use	61% 39%	36% 64%	6.0	.014
Residents with health problems	No use Some use	86% 14%	48% 52%	22.9	.000
Residents with no health problems	No use Some use	66% 34%	40% 60%	6.6	.010
Residents aged below 72 years	No use Some use	72% 28%	36% 64%	13.6	.000
Residents aged 73 to 80 years	No use Some use	86% 14%	64% 36%	8.4	.004
Residents 81 years and over	No use Some use	86% 14%	56% 44%	14.2	.000
Insufficiently active residents	No use Some use	92% 8%	76% 24%	6.5	.011
Sufficiently active residents	No use Some use	87% 13%	52% 48%	19.6	.000
Highly active residents	No use Some use	75% 25%	44% 56%	10.5	.001
Cottage residents	No use Some use	79% 21%	52% 48%	9.1	.003
Apartment residents	No use Some use	80% 20%	56% 44%	7.4	.003

Natural Features

Path segments with natural features along them were used no differently from path segments without natural features (p=0.844). This was true even when the analysis was conducted with the set of outdoor path segments only (p= 0.924). This was also true for path use by all categories of residents (p> 0.3 for all resident categories)

Parking

Outdoor path segments with parking areas along them were used no differently from outdoor path segments without parking areas for walking to destinations at PS (p=0.133). When path use by different categories was considered, we find that some residents – male residents (p= 0.018), those without health problems (p= 0.008) and residents aged 72 years and below (p= 0.022) – used a higher percentage of outdoor path segments with parking destinations along them. The relationship was marginal for residents with health problems (p=0.054). All other types of residents did not use outdoor path segments with parking areas any differently from outdoor path segments with parking (p> 0.083).

Path use for walking for recreation

Residential areas

When path use for recreational walking by all residents is considered, we find that there is no significant relationship between the presence of residential areas and use of path segments for walking (p=0.064). However, when path use by different categories of residents is considered we find that male and female residents, residents not using assistive devices, residents over 73, sufficiently active and highly active residents, and apartment residents used a higher percentage of path segments along residential areas as compared to path segments with no residential areas along them (Table 5.20).

Table 5.20: More path segments with residences along them are used for recreational walking

Segment use for recreational walking by…	Use category	Path segments with no residential areas	Path segment with residential areas	Chi-square	p-value
Male	No use Some use	54% 46%	38% 62%	4.9	.025
Female	No use Some use	41% 59%	23% 77%	6.2	.013
Residents not using any assistive device	No use Some use	34% 66%	20% 80%	3.9	.046
Residents aged 73 to 80 years	No use Some use	51% 49%	31% 69%	7.5	.006
Residents 81 years and over	No use Some use	75% 25%	45% 55%	18.9	.000
Sufficiently active residents	No use Some use	60% 40%	42% 58%	6.0	.014
Highly active residents	No use Some use	46% 54%	25% 75%	8.7	.003
Apartment residents	No use Some use	37% 63%	22% 78%	5.0	.025

Activity-related areas

Path segments with activity-related areas were used no differently for recreational walking on PS from path segments with no activity related areas along them (p=0.45). This was true when path use by all residents was considered and when path use by most categories of residents was considered (p between 0.17 and 0.9). The only exception was for path use by insufficiently active residents (p=.005). They used 16% of path segments with activity related destinations along them and only 3% of path segments without activity related destinations.

Natural features

Path segments with natural features (e.g. gazebo) were used no differently for recreational walking on PS from path segments with no natural features along them. This was true when path use by all residents was considered (p=0.6). This was also true when path use by different categories of residents was considered (p between 0.16 and 0.98), with the exception of residents using assistive devices. We find that PS residents using assistive devices chose a higher percentage (54%) of path segments with natural features for recreational walking as compared to path segments with no natural features (11%) (p= .000). Path segments with natural features such as those around the lake or in the landscaped courtyard were relatively flat, had seating along them and were easily visible from parking areas and clubhouse buildings. These path segments were less challenging and more supportive and thus, ideal for residents using assistive devices.

Parking

A higher percentage of path segments with parking areas (95%) were used for walking for recreation as compared to path segments without parking areas (65%) (Table 5.21). This was true for path use by many of the categories of residents. One of the reasons why path segments along parking areas were used for recreation could be their proximity to main entrances. At PS, all major parking lots were located in view of main entrances to residential buildings and clubhouse. Many recreational trips began and ended there. The relationship was not significant for residents using assistive devices (p=0.55), residents with health problems (p=0.115), residents aged 73 to 80 (p=0.214), residents aged 81 and over (p= 0.37), insufficiently active residents (p=0.14) and cottage residents (p=0.088).

Table 5.21: More path segments with parking were used for recreational walking

Segment use for walking for recreation by…	Use category	Path segments with no parking areas	Path segments with parking areas	Chi-square	p-value
Overall	No use Some use	35% 65%	5% 95%	12.5	.000
Male	No use Some use	53% 47%	30% 70%	7.6	.006
Female	No use Some use	40% 60%	16% 84%	8.2	.004
Residents not using any assistive device	No use Some use	34% 66%	8% 92%	10.5	.001
Residents with no health problems	No use Some use	35% 65%	8% 92%	11.1	.000
Residents aged below 72 years	No use Some use	49% 51%	8% 92%	21.9	.000
Sufficiently active residents	No use Some use	59% 41%	37% 63%	6.2	.013
Highly active residents	No use Some use	44% 56%	21% 79%	7.1	.008
Apartment residents	No use Some use	37% 63%	13% 87%	8.2	.004

5.3.1.15 Number of destinations on path segments

Table 5.22: Number of destinations present along path segments at PS.

Number of destinations along path	Number of path segments	Percent	Cumulative Percent
0	129	50.0	50.0
1	102	39.5	89.5
2	24	9.3	98.8
3	1	.4	99.2
4	2	.8	100.0
Total	258	100.0	

Fifty percent of the path segments have no destinations along them. Around 40% have one destination (Table 5.22). Thus, the key distinction appears to be between path segments that have some destinations versus path segments that have no destinations. For purpose of analysis, two categories were created – no destinations and one or more destinations. The path segments in red (Figure 5.12) have one or more destinations along them.

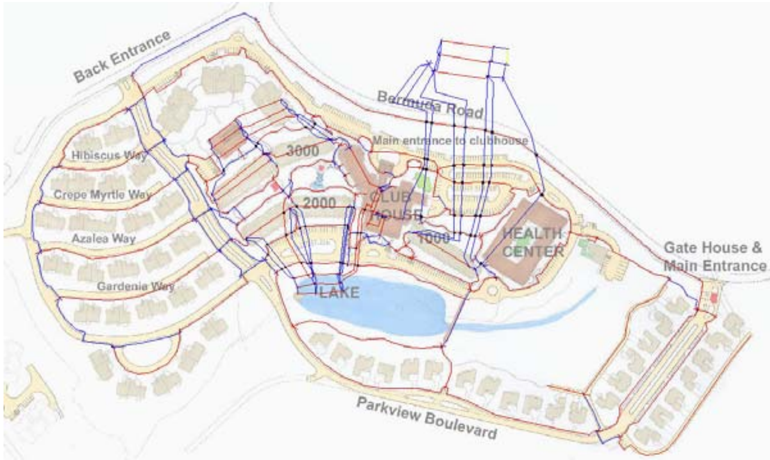


Figure 5.12: PS site plan with overlay of path segments with one or more destinations along them (red) and no destinations (blue)

Research question: Are more path segments with destinations along them used for walking for recreation/getting to destinations as compared to path segments with no destinations?

Path use for walking to destinations

Results: There is a relationship between the presence of destinations along the path segment and its use for walking to destinations. A higher percentage of path segments with one or more destinations (51%) were used for walking to destinations as compared to path segments with no destinations (32%) (Table 5.23). This relationship was true for path use by some, though not all categories of residents. Path segments with one or more destinations were used no differently from path segments with no destinations by residents with no assistive devices (p= 0.8), residents with health problems (p=0.085), residents aged 73 to 80 (p=0.26), residents aged 81 and over (p=0.057), insufficiently active residents (p=0.16), sufficiently active residents (p=0.16) and apartment residents (p=0.09).

Table 5.23: More path segments with one or more destinations along them were used for walking to destinations at PS

Segment use for getting to destinations by…	Use category	Path segment with no destinations	Path segments with one or more destinations	Chi-square	p-value
Overall	No use Some use	68% 32%	49% 51%	9.9	.002
Male	No use Some use	87% 13%	78% 22%	4.2	.04
Female	No use Some use	73% 27%	54% 46%	9.7	.002
Residents using assistive devices	No use Some use	68% 32%	49% 51%	9.9	.002
Residents with no health problems	No use Some use	74% 26%	53% 47%	12.2	.000
Residents aged below 72 years	No use Some use	78% 22%	59% 41%	10.5	.001
Highly active residents	No use Some use	78% 22%	65% 35%	5.0	.025
Cottage residents	No use Some use	83% 17%	70% 30%	5.7	.017

Path use for walking for recreation

There is a relationship between the presence of a destination along a path segment and its use for walking for recreation. As many as 81% of the path segments with one or more destinations were used for walking for recreation while 61% of path segments with no destinations were used for walking for recreation (Table 5.24). The relationship is not significant for residents using assistive devices (p=0.21) and insufficiently active residents (p=0.58).

Table 5.24: More path segments with one or more destinations along them were used for recreational walking at PS

Segment use for walking for recreation by…	Use category	Path segment with no destination	Path segments with one or more destinations	Chi-square	p-value
Overall	No use Some use	39% 61%	19% 81%	11.8	.001
Male	No use Some use	64% 36%	34% 66%	23.2	.000
Female	No use Some use	46% 54%	26% 74%	10.7	.001
Residents not	No use	40%	20%	11.6	.001

Table 5.24: More path segments with one or more destinations along them were used for recreational walking at PS

using any assistive device	Some use	60%	80%		
Residents with health problems	No use Some use	73% 27%	54% 46%	9.7	.002
Residents with no health problems	No use Some use	41% 59%	20% 80%	13.4	.000
Residents aged below 72 years	No use Some use	54% 46%	30% 70%	14.7	.000
Residents aged 73 to 80 years	No use Some use	54% 46%	38% 62%	6.6	.01
Residents 81 years and over	No use Some use	77% 23%	57% 43%	11.1	.001
Sufficiently active residents	No use Some use	68% 32%	43% 57%	16.9	.000
Highly active residents	No use Some use	51% 49%	30% 70%	12.1	.001
Cottage residents	No use Some use	67% 33%	47% 53%	9.7	.002
Apartment residents	No use Some use	44% 56%	23% 77%	12.9	.000

5.3.2 Relational path characteristics

5.3.2.1 Types of views

Many different types of views could be seen from 62% of the path segments at PS. Few (0-2 different views) views could be obtained from the rest of the segments. Eighty-three percent of the outdoor path segments had many different types of views. Indoor path segments through common areas such as the clubhouse also had many views. Some outdoor path segments along the perimeter of the campus and indoor path segments between resident apartments had few views (Figure 5.13).

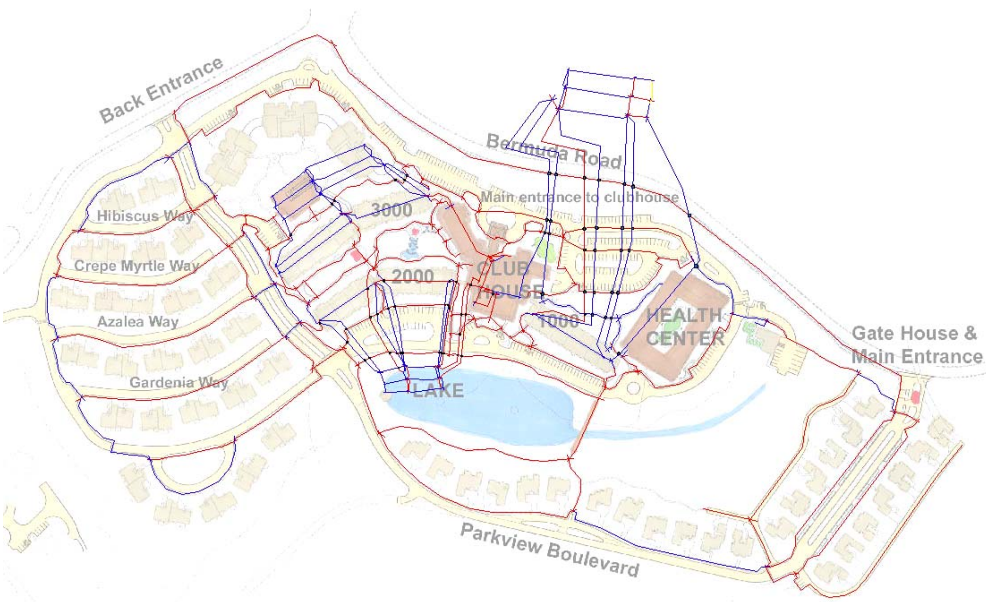


Figure 5.13: Path segments at PS with many views (red) and few views (blue)

Research Question:

Are more path segments, from which many different views can be seen, used for walking for recreation/to get to a destination as compared to path segments with few or no views?

Walking to get to destinations:

Results: Path segments with more views were used no differently from path segments with few or no views while walking to destinations on campus (p=0.49). This was also true for most resident categories (p>0.12). The relationship is significant for cottage residents and apartment residents. Interestingly enough, cottage residents used 33% of path segments with many views and only 9% of path segments with few views (p=0.000). Apartment residents used 31% of path segments with few views and only 17% of path segments with many views (p=0.007). Thus, the opposite is true for these two types of residents. This finding may be explained in the light of the fact that cottage residents walk outdoors and through the clubhouse (path segments with many views) to get to destinations, while apartment residents primarily walk along resident corridors which have few views.

Walking for recreation

Results: A higher percentage of path segments with many views (75%) were used for recreational walking as compared to path segments with no or few views (63%) (Table 5.25). When path use by categories of residents was considered, the number of views from the path segment was related to path use for recreation by male residents, residents not using assistive devices, residents with no health problems and residents aged below 72 years. Path segments with many views were used no differently from path segments with few views by other types of residents (p>0.2)

Table 5.25: More path segments with many different types of views were used for recreational walking as compared to path segments with few views

Segment use for walking for recreation by…	Use category	Path segment with no views or few views	Path segments with many views	p-value	Chi-square
Overall	No use Some use	37% 63%	25% 75%	.028	4.8
Male	No use Some use	59% 41%	44% 56%	.023	5.2
Residents not using any assistive device	No use Some use	38% 62%	25% 75%	.024	5.0
Residents with no health problems	No use Some use	39% 61%	26% 74%	.022	5.3
Residents aged below 72 years	No use Some use	53% 47%	37% 63%	.011	6.4

5.3.2.2 Presence of specific views

Table 5.26: Types of views that can be seen from path segments at PS

Type of View	**Number of path segments with view**	**%**
Residential	225	87
Water (river, lake)	41	16
Tended nature	177	69
Untended nature	17	7
Public spaces	58	23
Destinations (not on path)	153	59
Parking	76	30
Art	41	16
No views	3	1

Many different types of views could be seen from most (62%) of the path segments. Views of residential areas were the most common (87%) (Figure 5.14). Many of the path segments at PS had views to landscaped areas on campus (69%) and to destinations not on the path, but visible from the path (59%). Other types of views that were common include views of parking and views of public spaces such as lounges and plazas (Table 5.26).

Research Question:

Are more path segments from which specific types of views can be seen used for walking for recreation/to get to a destination as compared to path segments from which this view cannot be obtained?

<u>Path use for getting to destinations</u>

View of residential areas

The results show that more path segments *without* views to residential areas were used for walking to destinations on PS as compared to path segments with views to residential areas (Table 5.27). This relationship holds true for path use by different categories of residents as well. Of the path segments without views to residential areas 86% were located within the clubhouse (can also be seen in Figure 5.14). Thus, this finding may be less about the absence of residential views than the presence of some key destinations in the clubhouse that residents walked to.

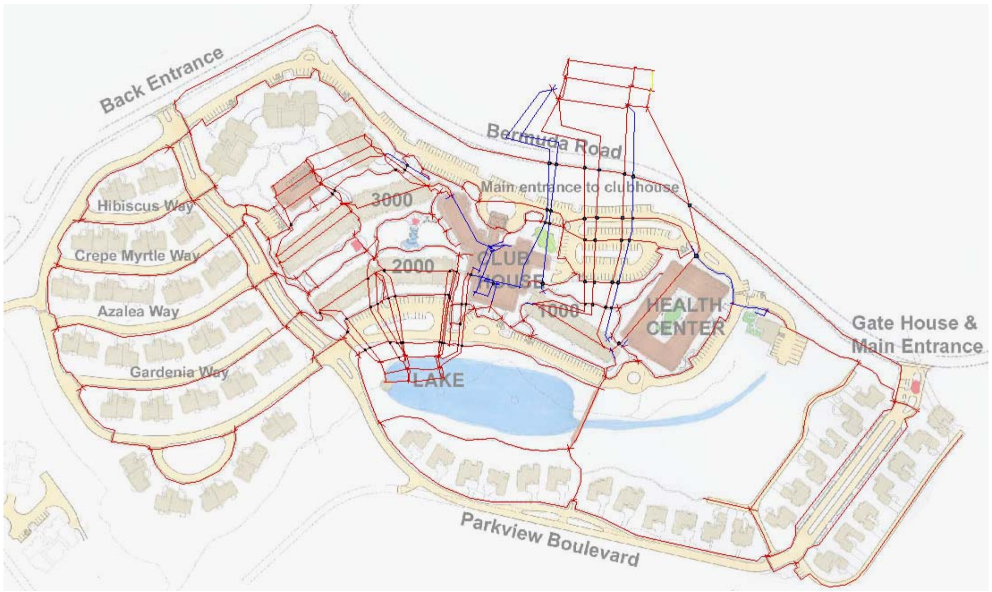


Figure 5.14: PS site plan with overlay of path segments with residential views (red)

Table 5.27: Fewer path segments *with* views to residential areas were used for walking to destinations

Segment use for walking to destinations by…	Use category	Path segments with no view of residential areas	Path segments with views to residential areas	Chi-square	p-value
Overall	No use Some use	36% 64%	62% 38%	7.9	.005
Male	No use Some use	64% 36%	85% 15%	9.4	.002
Female	No use Some use	39% 61%	68% 32%	9.9	.002
Residents using assistive devices	No use Some use	76% 24%	98% 2%	29.1	.000
Residents not using any assistive device	No use Some use	36% 64%	62% 38%	7.9	.005
Residents with health problems	No use Some use	58% 42%	86% 14%	16.4	.000
Residents with no health problems	No use Some use	36% 64%	68% 32%	12.1	.001
Residents aged below 72 years	No use Some use	39% 61%	73% 27%	14.9	.000
Residents aged 73 to 80 years	No use Some use	64% 36%	87% 13%	11.9	.001
Residents 81 years and over	No use Some use	52% 48%	88% 12%	26.4	.000
Insufficiently active residents	No use Some use	70% 30%	93% 7%	18.4	.000
Sufficiently active residents	No use Some use	58% 42%	87% 13%	18.0	.000
Highly active residents	No use Some use	46% 54%	76% 24%	12.8	.000
Cottage residents	No use Some use	49% 51%	80% 20%	16.3	.000
Apartment residents	No use Some use	55% 45%	81% 19%	11.5	.001

View of water

A higher percentage (67%) of path segments with views to water (the lake at PS) were used for walking to get to destinations as compared to path segments with no views to water (lake) (37%). This relationship also holds true for path use for getting to destinations for most categories of residents. This was particularly true for cottage residents – they used 61% of the path segments with views to water and only 17% of the path segments without views to water (Table 5.28). This is probably explained by the fact that the clubhouse entry that is closest to the cottages faces the lake and cottages residents need to pass by the lake in order to reach the clubhouse (Figure 5.15). It is more difficult to explain why this relationship holds true for path use by all other categories of residents.

Figure 5.15: PS site plan with overlay of path segments with views of water (red)

Table 5.28: More path segments with views to water were used for walking to destinations at PS

Segment use for walking to destinations by…	Use category	Path segments with no view of water	Path segments with views of water	Chi-square	p-value
Overall	No use Some use	63% 37%	37% 63%	10.0	.002
Male	No use Some use	86% 14%	66% 34%	9.4	.002
Female	No use Some use	67% 33%	49% 51%	4.8	.027
Residents not using any assistive device	No use Some use	63% 37%	37% 63%	10.0	.002
Residents with no health problems	No use Some use	68% 32%	39% 61%	12.7	.000
Residents aged below 72 years	No use Some use	74% 26%	39% 61%	19.8	.000
Residents 81 years and over	No use Some use	88% 12%	59% 41%	20.5	.000
Insufficiently active residents	No use Some use	92% 8%	80% 20%	5.4	.02
Highly active residents	No use Some use	76% 24%	51% 49%	10.1	.001
Cottage residents	No use Some use	83% 17%	39% 61%	37.6	.000
Apartment residents	No use Some use	75% 25%	93% 7%	6.4	.011

Views of tended nature

Overall, path segments with views of tended nature (landscaped areas) were used no differently for getting to destinations on PS from path segments without views to tended nature (p=0.12). However, when we consider path use by different resident categories we find that more path segments with *no views* of tended nature were used for walking to destinations as compared to path segments with views of tended nature. However, the opposite is true for cottage residents (Table 5.29). This again may relate to the fact that cottage residents walked along outdoor paths (which have nature views) to destinations as opposed to apartment residents who walk indoors (with few views of tended nature).

Table 5.29: More path segments with no views of tended nature were used for walking to destinations at PS

Segment use for walking to destinations by…	Use category	Path segments with no view of tended nature (%)	Path segments with views of tended nature (%)	Chi-square	p-value
Male	No use Some use	70 30	88 12	12.1	.000
Residents using assistive devices	No use Some use	90 10	97 3	5.5	.016
Residents with health problems	No use Some use	73 27	87 13	7.7	.005
Residents with no health problems	No use Some use	54 46	68 32	4.3	.037
Residents aged 73 to 80 years	No use Some use	70 30	90 10	16.6	.000
Residents 81 years and over	No use Some use	75 25	86 14	4.8	.027
Sufficiently active residents	No use Some use	66 34	91 9	23.6	.000
Cottage residents	No use Some use	85 15	72 28	5.1	.024
Apartment residents	No use Some use	58 42	86 14	25.7	.000

Views of untended nature

Path segments with views of untended nature (wooded areas) were used no differently for getting to destinations on PS from path without views to untended nature (p=0.6). The relationship is also true for path use by all resident categories (p>=0.1) except cottage residents (p= 0.019) and apartment residents (p=0.022). However, as before apartment residents used more path segments *with no* views of untended nature as compared to path segments with views. The opposite is true for cottage residents.

Views of public spaces (lobby, plaza)

A higher percentage of path segments with views to public spaces (lobby, plaza etc.) were used for walking to destinations as compared to path segments with no views to such spaces (Table 5.30). This relationship was also true for path use for getting to destinations for most categories of residents.

Table 5.30: More path segments with views to public places were used for walking to destination at PS

Segment use for walking to destinations by…	Use category	Path segments with no view of public spaces	Path segments with views of public spaces	Chi-square	p-value
Overall	No use Some use	65% 35%	40% 60%	11.5	.001
Female	No use Some use	71% 29%	41% 59%	16.5	.000
Residents using assistive devices	No use Some use	97% 3%	88% 12%	7.7	.005
Residents not using any assistive device	No use Some use	65% 35%	40% 60%	11.5	.001
Residents with health problems	No use Some use	88% 12%	66% 34%	15.1	.000
Residents with no health problems	No use Some use	68% 32%	48% 52%	7.5	.006
Residents aged below 72 years	No use Some use	74% 26%	52% 48%	9.9	.002
Residents between 73 and 80 years	No use Some use	89% 11%	67% 33%	15.9	.000
Residents 81 years and over	No use Some use	86% 14%	74% 26%	4.1	.043
Sufficiently active residents	No use Some use	88% 12%	67% 33%	13.9	.000
Highly active residents	No use Some use	77% 23%	55% 45%	10.1	.001
Cottage residents	No use Some use	82% 18%	59% 41%	13.0	.000
Apartment residents	No use Some use	82% 18%	62% 38%	10.2	.001

Views to other destinations (not on path)

Path segments with views to other destinations that were not on it were used no differently for getting to destinations as compared to path segments without views to such spaces (p=0.19). This relationship was true when path use by different resident categories was considered (p>0.75). The only exception is for path use by cottage residents. Thirty three percent of path segments with views to destinations not on path were used for walking to destination by cottage residents while only 10% of path segments without such views were used (p=0.000).

Views to parking

Path segments with views to parking were used no differently for getting to destinations on PS as compared to path segments without views to parking (p=0.62). This was also true for path use by resident categories (p>0.05).

Views to art

A higher percentage of path segments with views of artwork (80%) were used for walking to destinations as compared to path segments with no views of artwork (34%) (Table 5.31). The relationship is highly significant. Further, this holds true for path use by all resident categories. Figure 5.16 shows that most of the path segments with artwork were the path segments between apartments and the path segments in the clubhouse. Clearly, these path segments were used for getting to destinations by the apartment residents.

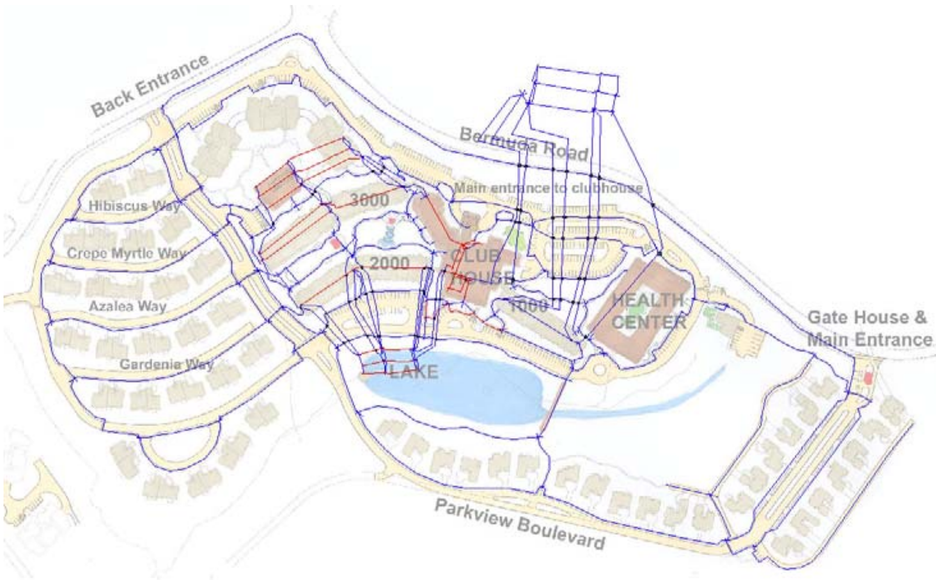


Figure 5.16: PS site plan with overlay of path segments with views to artwork

Table 5.31: More path segments with views to artwork were used for walking to destinations at PS

Segment use for walking to destinations by…	Use category	Path segments with no view of art	Path segments with views of art	Chi-square	p-value
Overall	No use Some use	66% 34%	20% 80%	31.3	.000
Male	No use Some use	89% 11%	46% 54%	44.4	.000
Female	No use Some use	71% 29%	29% 71%	25.4	.000
Residents using assistive devices	No use Some use	97% 3%	83% 17%	14.7	.000
Residents not using any assistive device	No use Some use	66% 34%	20% 80%	31.3	.000
Residents with health problems	No use Some use	90% 10%	49% 51%	38.6	.000
Residents with no health problems	No use Some use	71% 29%	22% 78%	36.4	.000
Residents aged below 72 years	No use Some use	74% 26%	42% 58%	16.7	.000
Residents between 73 and 80 years	No use Some use	90% 10%	54% 46%	33.8	.000
Residents 81 years and over	No use Some use	89% 11%	49% 51%	40.2	.000
Insufficiently active residents	No use Some use	95% 5%	66% 34%	33.3	.000

Table 5.31: More path segments with views to artwork were used for walking to destinations at PS

Sufficiently active residents	No use Some use	89% 11%	51% 49%	36.2	.000
Highly active residents	No use Some use	77% 23%	42% 58%	21.9	.000
Cottage residents	No use Some use	80% 20%	56% 44%	11.1	.001
Apartment residents	No use Some use	85% 15%	39% 61%	41.4	.000

Path use for recreational walking

The presence of any specific type of view from path segments was not related to its use for walking for recreation on PS. Thus, path segments with views to residential areas (p=0.35), water (p=0.06), tended (p=0.07) and untended nature (p=0.57), public places (p=0.34), destinations not on path (p=0.07) or art (p=0.12) were used no differently from path segments with these views.

5.3.3 Global Path Characteristics

Depth

The depth between two segments is the minimum number of spaces that must be traversed to go from one to the other. This variable is a measure of centrality of a path segment with respect to the network of path segments. The site plan of PS shows a gradient of depth values (from red to purple to blue) where red indicates path segments that are the most central while blue path segments are the deepest (least central within the network(Figure 5.17).

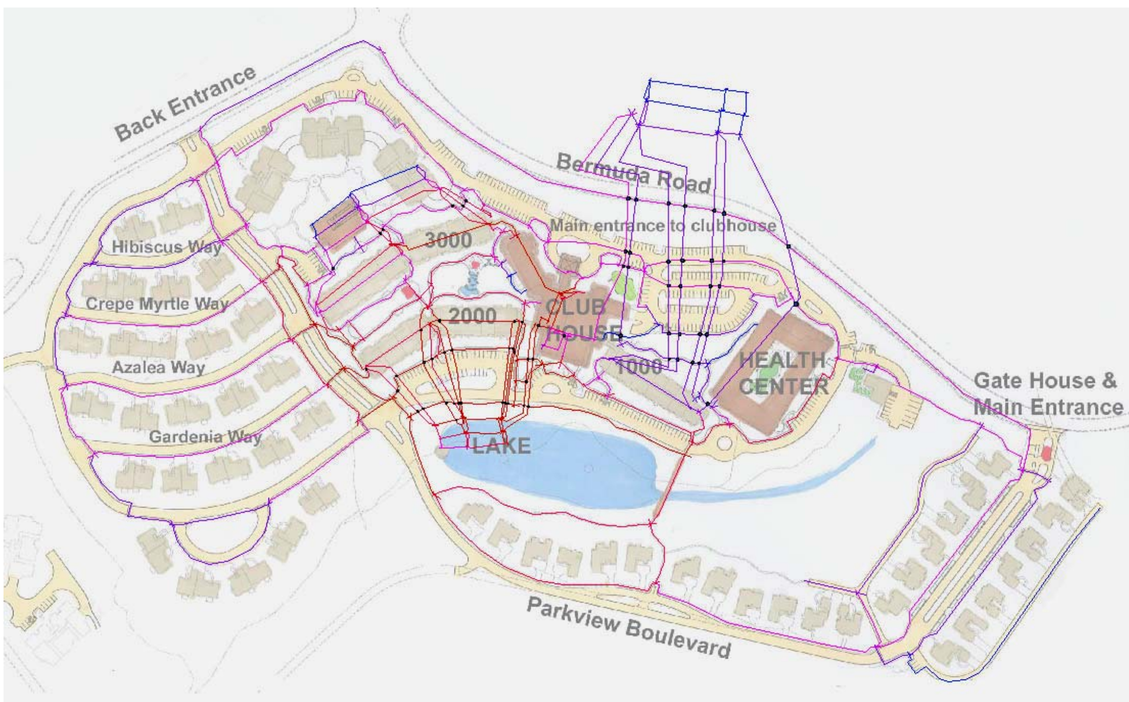


Figure 5.17: PS site plan with overlay of path segments showing a gradient of mean depth values

The most central (shallow) path segments are located at the center of the campus. Path segments in villa building 2000, the clubhouse and the path segments around the lake are the closest to all other path segments on campus. Path segments in villa buildings 3000 and 1000 are not as central within the path network (Figure 5.17).

For the purpose of analysis depth values were collapsed into two main categories around the mean – less central and more central. The site plan of PS (Figure 5.19) shows the distribution of path segments on campus based on the above definition of depth.

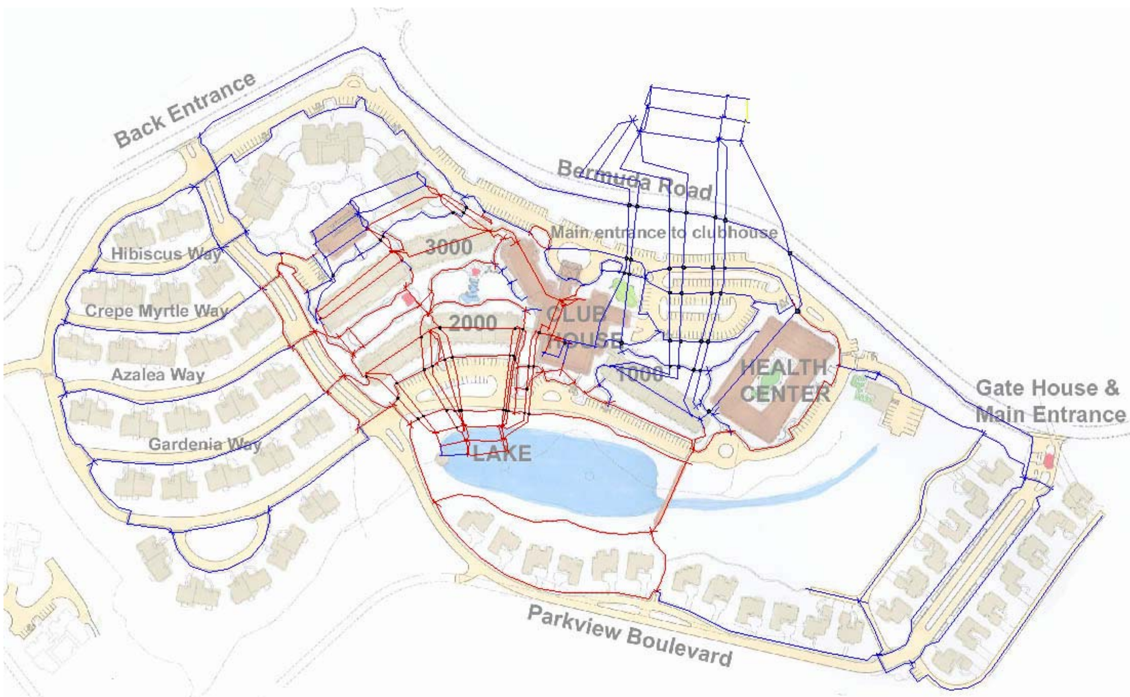


Figure 5.18: PS site plan with overlay of path segments that are less central (blue) and more central (red) within the campus path network

Research question: Are path segments that are closer to all other path segments on campus (more central) used for walking for recreation/getting to destinations as compared to path segments that are farther away from all other path segments (less central) on campus?

<u>*Path use for getting to destinations*</u>

Results: The analysis shows that a higher percentage of more central path segments (55%) were used for getting to destinations on campus as compared to path segments that were less central in the system (27%) (Table 5.32). This was true when path use by categories of residents was considered as well. There was no difference between more central and less central path segments in terms of their use by residents using assistive devices ($p<0.05$).

Table 5.32: More central path segments were used for walking to destinations as compared to path segments that were less central

Segment use for walking to destinations by….	Use category	Path segments that are less central within the network	Path segments that are more central within the network	Chi-square	p-value
Overall	No use Some use	73% 27%	45% 55%	21.7	.000
Male	No use Some use	92% 8%	73% 27%	14.7	.000
Female	No use Some use	75% 25%	53% 47%	12.9	.000
Residents not using any assistive device	No use Some use	73% 27%	45% 55%	21.7	.000
Residents with health problems	No use Some use	89% 11%	77% 23%	6.3	.012
Residents with no health problems	No use Some use	76% 24%	51% 49%	17.9	.000
Residents aged below 72 years	No use Some use	78% 22%	59% 41%	10.0	.002
Residents aged 73 to 80 years	No use Some use	92% 8%	76% 24%	13.1	.000
Residents 81 years and over	No use Some use	89% 11%	77% 23%	5.6	.018
Insufficiently active residents	No use Some use	95% 5%	86% 14%	5.5	.018
Sufficiently active residents	No use Some use	92% 8%	75% 25%	12.7	.000
Highly active residents	No use Some use	84% 16%	59% 41%	19.0	.000
Cottage residents	No use Some use	86% 14%	66% 34%	13.9	.000
Apartment residents	No use Some use	86% 14%	69% 31%	11.2	.001

Path use for recreation

There is a significant relationship between the centrality of path segments and their use for walking for recreation ($p= .017$). Around 77% of path segments that were more central were used for walking for recreation while 64% of the less central path segments were used (Table 5.33). When path use by different categories of residents was considered, we found that the relationship was true for female residents, residents not using assistive devices, residents with and without health problems, residents over 81 years and apartment residents.

Table 5.33: More central path segments were used for walking for recreation at PS as compared to path segments that were less central.

Segment use for walking for recreation by….	Use category	Path segments that are less central within the network	Path segments that are more central within the network	Chi-square	p-value
Overall	No use Some use	36% 64%	23% 77%	5.6	.017
Female	No use Some use	42% 58%	31% 59%	3.9	.048
Residents not using any assistive device	No use Some use	37% 63%	23% 77%	5.6	.018
Residents with health problems	No use Some use	71% 29%	57% 43%	5.3	.022
Residents with no health problems	No use Some use	37% 63%	25% 75%	4.3	.038
Residents 81 years and over	No use Some use	76% 24%	59% 41%	9.1	.003
Apartment residents	No use Some use	41% 59%	26% 74%	6.5	.011

Choice (betweenness centrality)

This is a measure of how many times a path segment will be found lying on routes connecting two path segments in the system. That is, the number of routes that the path segment is potentially a part of in the system of path segments on campus. Five percent of all path segments do not lie between any two path segments – that is they form a dead end. Path segments were organized into two categories about the median – low choice and high choice. Figure 5.19 shows the distribution of paths on the PS campus based on this definition of choice. Path segments in red lie on many routes connecting path segments on campus.

Figure 5.19: High choice (red) and low choice (blue) path segments at PS

Research question: Are more path segments that lie on many routes on campus likely to be used for instrumental/ recreational walking?

Path use for walking to destinations

Results: A higher percentage of path segments that lay on many routes connecting path segments on campus were used for walking to destinations at PS as compared to path segments that lay on few routes (Table 5.34). This was true when path use by all categories of residents was considered as well, with the exception of path use by residents reporting health problems.

Table 5.34: More path segments that were part of more routes on campus were used for walking to destinations at PS

Segment use for walking to destinations by…	Use category	Path segments with few choice	Path segments with many choices	Chi-square	p-value
Overall	No use Some use	77% 23%	62% 38%	6.5	.011
Male	No use Some use	89% 11%	76% 24%	6.9	.008
Female	No use Some use	81% 19%	66% 34%	7.6	.006
Residents using assistive device	No use Some use	99% 1%	91% 9%	7.0	.008
Residents not using any assistive devices	No use Some use	77% 23%	61% 39%	7.1	.007
Residents without health problems	No use Some use	75% 25%	52% 48%	15.3	.000
Residents aged 72 or less	No use Some use	80% 20%	57% 43%	15.0	.000
Residents between 73 to 80 years	No use Some use	90% 10%	78% 22%	7.4	.007
Residents aged 81 and over	No use Some use	88% 12%	79% 21%	4.6	.031
Insufficiently active residents	No use Some use	95% 5%	86% 14%	5.9	.015
Sufficiently active residents	No use Some use	91% 9%	75% 25%	11.2	.001
Highly active residents	No use Some use	83% 17%	60% 40%	15.7	.000
Cottage residents	No use Some use	84% 16%	68% 32%	8.9	.003
Apartment residents	No use Some use	85% 15%	70% 30%	8.3	.004

Path use for walking for recreation

There was a relationship between choice and path use for walking for recreation on PS. This relationship was significant for path use by all categories of residents except residents aged 81 and over. We find that a higher percentage of high choice path segments were used for walking for recreation as compared to low choice path segments (Table 5.35).

Table 5.35: More path segments that were part of many routes on campus were used for recreation.

Segment use for walking for recreation by…	Use category	Path segments with few choices	Path segments with many choices	Chi-square	p-value
Overall	No use Some use	79% 21%	52% 48%	21.1	.000
Male	No use Some use	86% 14%	63% 37%	17.7	.000
Female	No use Some use	75% 25%	46% 54%	22.7	.000
Residents using assistive device	No use Some use	95% 5%	79% 21%	13.6	.000
Residents not using any assistive devices	No use Some use	65% 35%	37% 63%	21.2	.000
Residents with health problems	No use Some use	75% 25%	52% 48%	14.3	.000
Residents without health problems	No use Some use	70% 30%	38% 62%	25.9	.000
Residents aged 72 or less	No use Some use	71% 29%	50% 50%	12.2	.000
Residents between 73 to 80 years	No use Some use	76% 24%	41% 59%	33.1	.000
Insufficiently active residents	No use Some use	100% 0%	91% 9%	13.2	.000
Sufficiently active residents	No use Some use	83% 17%	59% 41%	17.7	.000
Cottage residents	No use Some use	66% 34%	48% 52%	8.1	.005
Apartment residents	No use Some use	76% 24%	45% 55%	23.8	.000

5.4 Analysis of high use path segments

In order to understand if there was a difference between different groups of residents in terms of the path segments that were highly used for recreational walking, the twenty path segments that were used most (for recreation) by different resident categories were identified and compared.

<u>Overall path use for recreation:</u>

The path segments in red (Figure 5.20) are the 20 path segments that were used most number of times for recreation by PS residents. Indoor path segments that were used highly include the path segments on the main floor of the clubhouse. The path segments around the lake and up to the health center were used highly. Also, the road crossover from the cottages to the lake was used often as part of a recreational route.

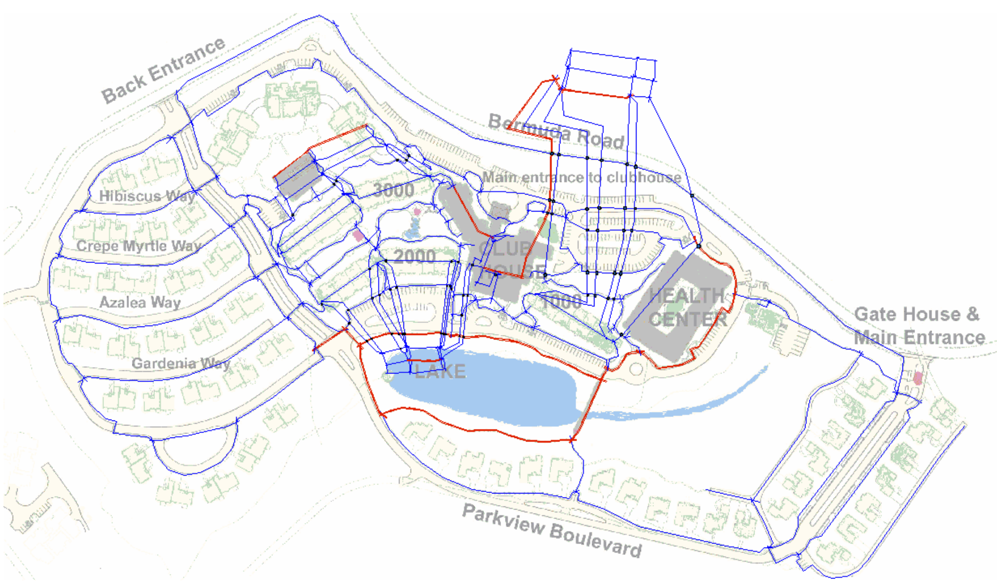


Figure 5.20: Path segments in red are used most for recreation on the PS campus

Gender

Both male and female residents walked around the lake for recreation. Male residents also walked up the hill from the lake to the health center (figure 5.21). Both male and female residents (Figure 5.22) used the clubhouse segments and resident corridors highly for recreational walking.

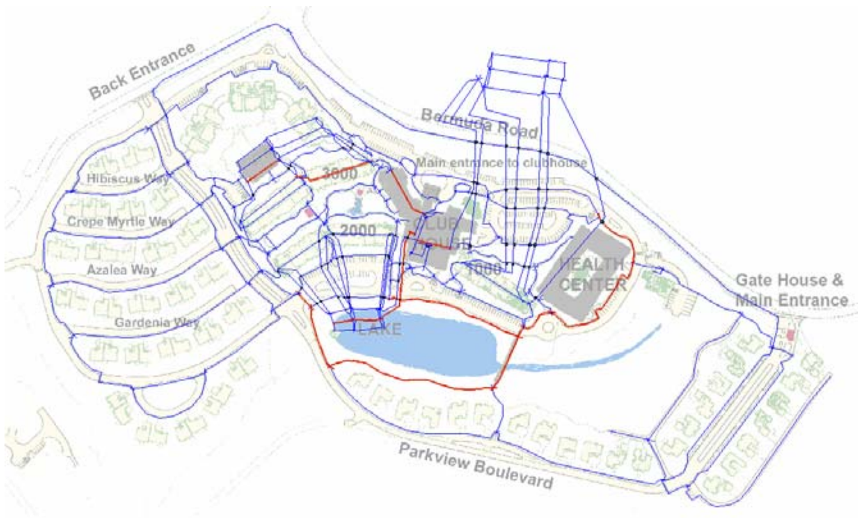


Figure 5.21: Path segments in red are used most my male residents

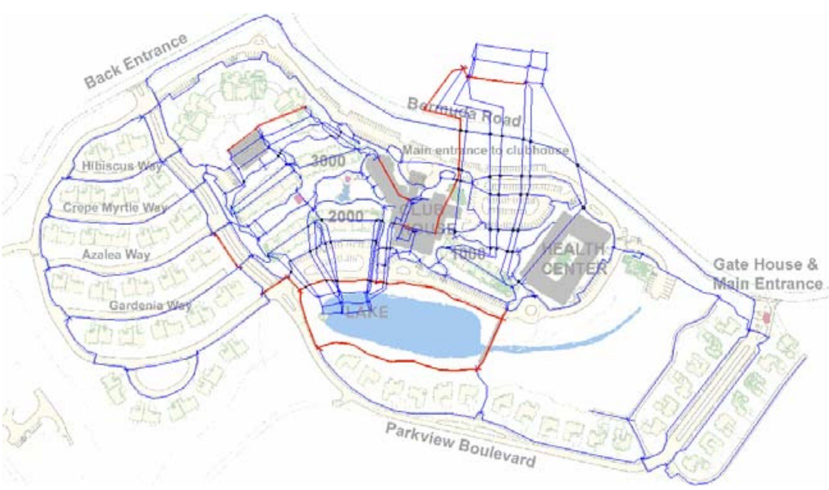


Figure 5.22 : Path segments in red are used most by female residents

Use of assistive device

Residents using assistive devices walked along the path segments close to two main entrances to the clubhouse – from the front entrance of the clubhouse to the health center through the parking lot or around the lake (figure 5.23). On the other hand residents who did not use assistive devices walked around the lake and indoors in the clubhouse and between apartments in the apartment buildings (figure 5.24).

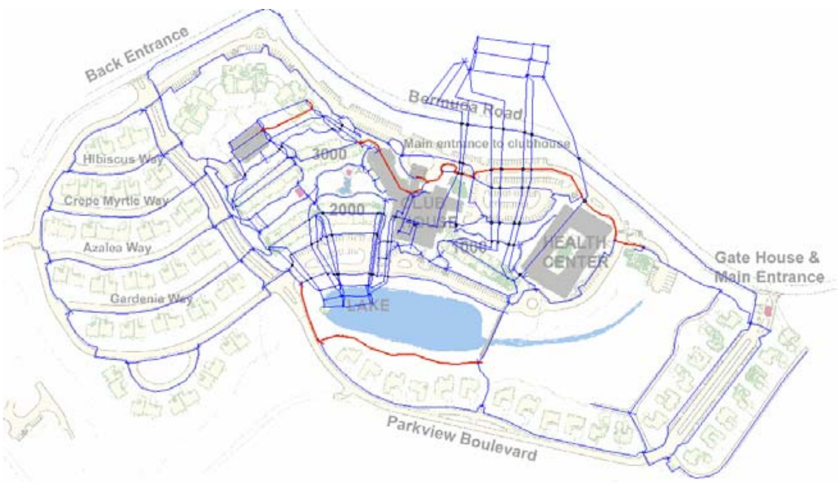


Figure 5.23: Path segments in red were used most by residents using assistive devices

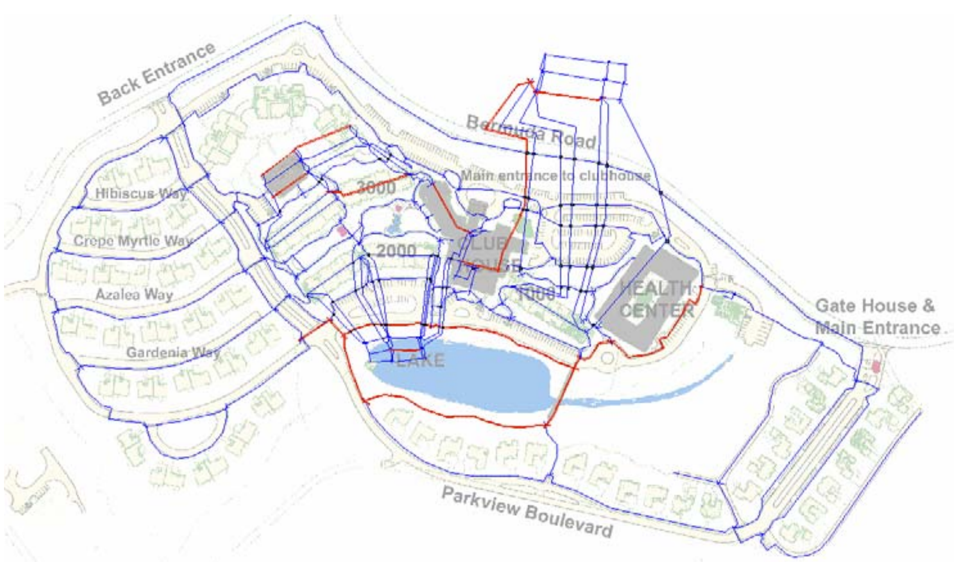


Figure 5.24: Path segments in red were used most by residents not using any assistive devices

Health Problems

Residents reporting health problems in the last 6 months that affected their walking behavior walked around the lake and between the cottages. They also walked indoors in the clubhouse and between resident apartments in the 3000 and 1000 villa buildings (Figure 5.25). Residents not reporting health problems also used the same path segments highly for recreation. However, they did not use the path segments between cottages a lot for recreational walking (Figure 5.26).

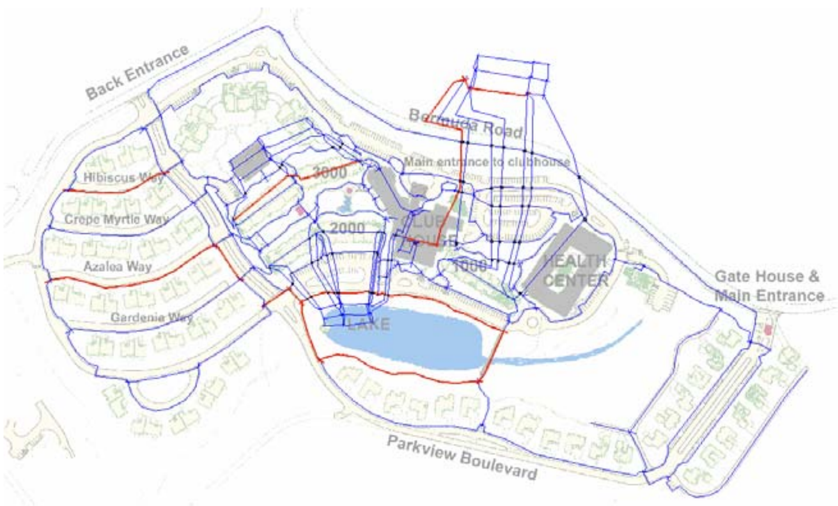


Figure 5.25: Path segments in red were used highly by residents reporting any health problems

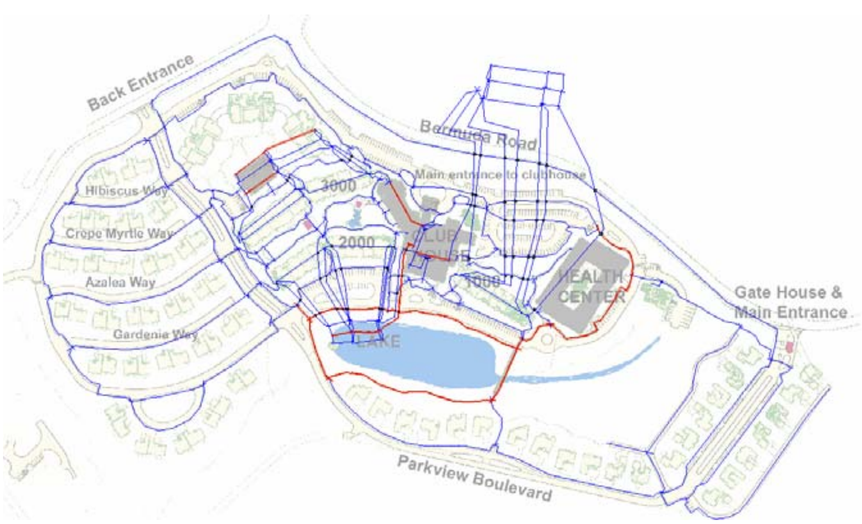


Figure 5.26: Path segments in red were used highly by residents not reporting health problems

Age

The age of the residents seems to be related to the extent of their recreational route around campus. We see that the youngest residents (aged 72 or less) walked all over campus – from the gatehouse (front entrance to campus) to the path segments between the cottages to the path around the lake. They did not use many indoor path segments for recreation (Figure 5.27). Residents between 73 and 80 used path segments that were closer to the clubhouse – the path segments from the lake – around the health center and leading to the main entrance to the clubhouse were used a lot. These residents also used indoor path segments in the clubhouse and between resident apartments (Figure 5.28). The path segments that were highly used by residents over 81 were the path segments around the lake. Other outdoor path segments were not used often by residents in this age category. For residents over 81, highly used indoor path segments included path segments in the clubhouse and between resident apartments in the 3000 villa building (Figure 5.29).

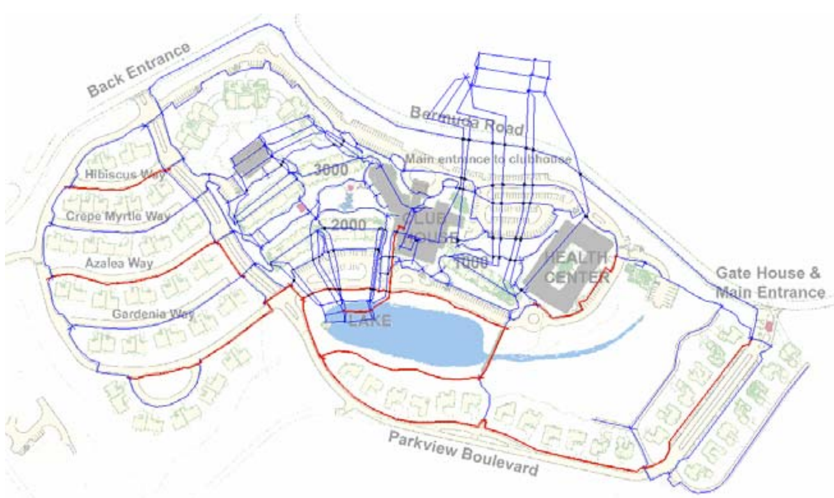


Figure 5.27: Path segments in red were used most by resident aged 72 or less

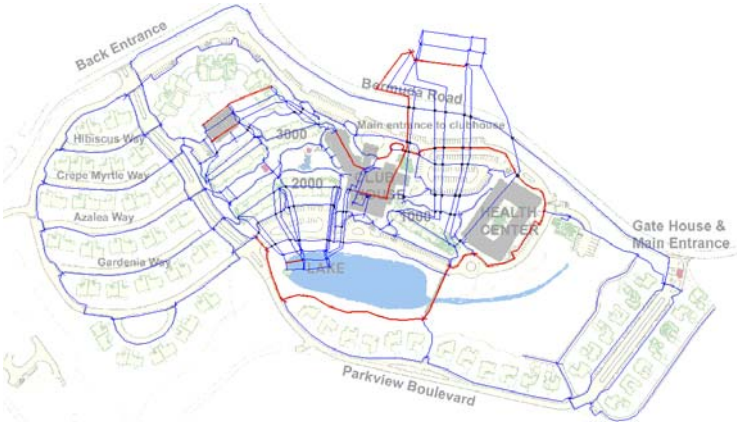


Figure 5.28: Path segments in red were used most by residents between 73 and 80.

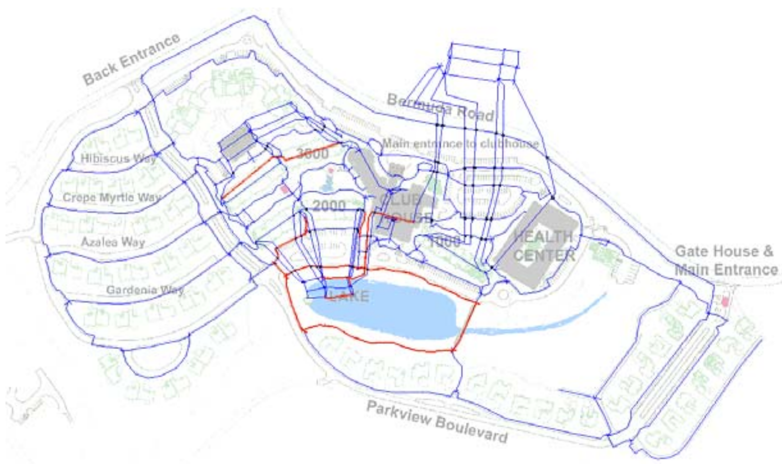


Figure 5.29: Path segments in red were used most by residents aged 81 or over.

Physical activity level

The path segments that were used often by insufficiently active residents were all indoors – between resident apartments in the 3000 and 1000 buildings and in the clubhouse building (figure 5.30). Sufficiently active residents used indoors path segments between resident apartments in 3000 and 1000 villa buildings and outdoor path segments – around the lake, by the health center and to the main entrance to the clubhouse (figure 5.31). Sufficiently active and highly active residents (figure 5.32) used the similar set of path segments highly for recreation.

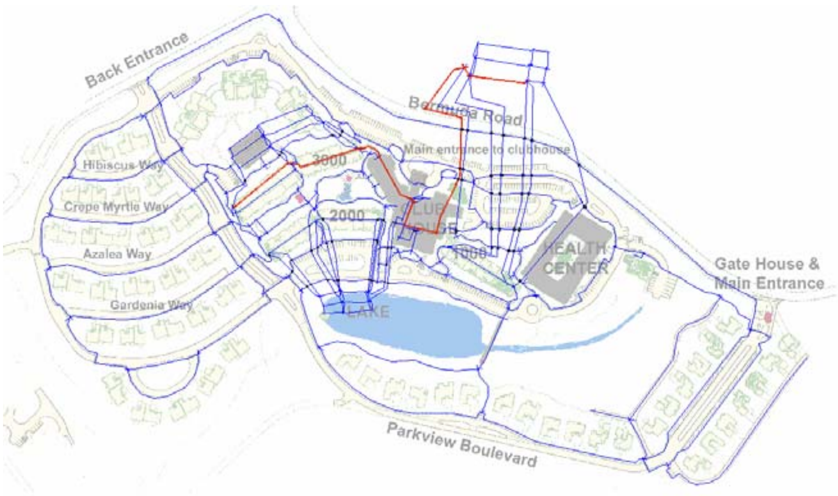


Figure 5.30: Path segments in red were used most by insufficiently active residents

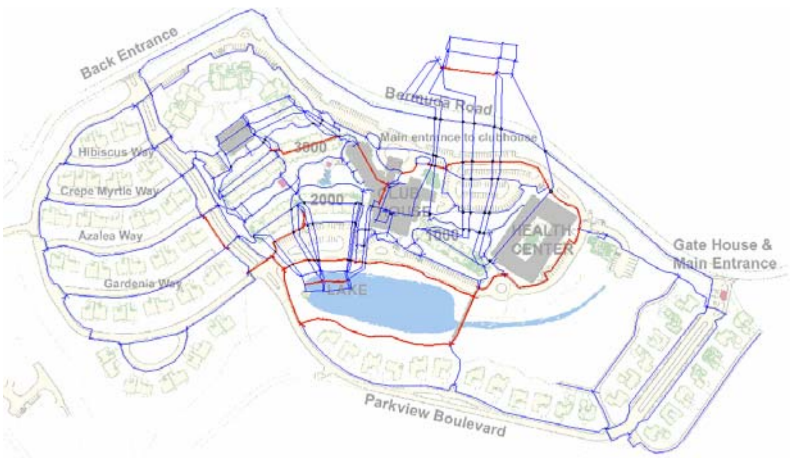


Figure 5.31: Path segments in red were used most by sufficiently active residents

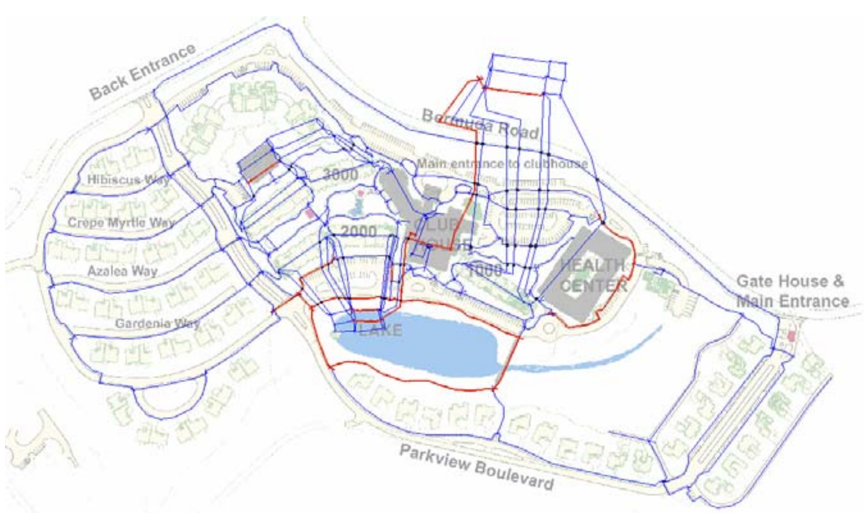


Figure 5.32: Path segments in red were used most by highly active residents.

Type of residence

Path segments that were used highly by cottage residents are all outdoor path segments (Figure 5.33). Path segments leading from the main campus entrance (in front of the cottages) to the lake, path segments around the lake and path segments in front of the cottages on the west side of the campus were used often by cottage residents. Path segments that were used a lot by apartment residents were mostly located close to the clubhouse and apartment buildings (Figure 5.34). Outdoor path segments around the lake and by the health center were used most. Apartment residents did not use path segments between cottages often. They used indoor path segments in the clubhouse and between resident apartments for recreation.

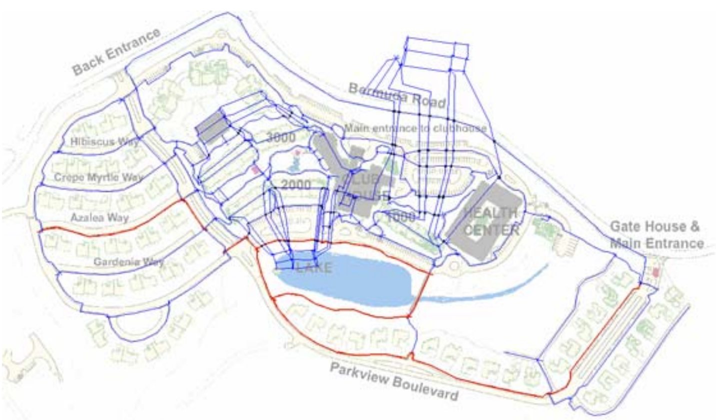


Figure 5.33: Path segments in red were used most by cottage residents

Figure 5.34: Path segments in red were used most by apartment residents

5.5 Analysis of highly used recreation routes

From an analysis of the path characteristics of highly used path segments, it is important to make a transition to an understanding about the characteristics of the routes that were used a lot for walking. While individual segment characteristics tell us something about the why people may choose to walk there, it is also important to understand if there are certain characteristics of the overall route that people choose while walking for recreation.

Outdoor routes:

The analysis of all resident responses shows that there are 5 types of outdoor routes that were used for recreation by residents. Sometimes, residents used a combination of these routes to complete their walk. The most striking aspect of all these outdoor routes is the fact that these outdoor routes make loops around campus (started at one point and ended back there without repeating the path). However, these loops are different in terms of the length and characteristics of the path segments along them (Figure 5.35). Other than these loops, some residents also walked up and down the same path for recreations (linear routes).

Figure 5.35: The most highly used outdoor routes on the PS campus

Table 5.36 shows the number of residents in different categories that chose different types of routes for walking. For all the routes, the number of residents who chose only that route for walking is shown below. The number of residents who used a combination of one or more routes is also shown. Indoor routes were also chosen for recreational walking. Indoor route 1 was extensive and involved walking all floors of all buildings on campus while indoor route 2 involved walking only a part of that route.

Table 5.36: Number of residents who chose different route for recreational walking at PS

Number of residents that used…		**Only Route 1**	**Only Route 2**	**Only Route 3**	**Only Route 4**	**Only Route 5**	**Combination routes**	**Linear routes**	**Indoor route 1**	**Indoor route 2**
Age	72 years or less	3	0	1	0	1	7	1	3	3
	73-80 years	2	1	1	0	0	5	1	1	5
	81 years and over	4	0	1	0	1	0	0	0	5
Gender	Male	2	0	2	0	1	5	0	2	6
	Female	7	1	1	0	1	7	2	2	7
Type of residence	Apartment	8	1	2	0	2	7	2	2	12
	Cottage	1	0	1	0	0	5	0	2	1
Use assistive device for walking?	No	9	1	3	0	2	11	1	3	13
	Yes	0	0	0	0	0	1	1	1	0
Experienced health problems recently that affected walking	No	8	1	3	0	2	10	1	4	10
	Yes	1	0	0	0	0	2	1	0	3
Physical activity level (based on IPAQ)	Insufficiently active	0	0	0	0	0	0	0	0	1
	Sufficiently active	5	0	2	0	0	2	0	1	2
	Highly active	3	0	1	0	0	8	2	3	7

Route 1: This route made a complete circle around the lake (Figure 5.35). This route was almost level throughout with places to sit. Attractive views of the lake and the campus could be seen from along this path segment. Further, the lake was visible from many parts of campus. The path segments along this route were wider than other sidewalk segments. One circle around the lake is about 0.30 mile long. Figure 5.18, shows that the path segments around the lake were more central – that is they are accessible from all other parts of the campus. Also, most of the path segments that make up this route were

high choice segments (Figure 5.19). This was the most popular route among PS residents. As many as nine residents walked exclusively around the lake during their walk. More of the oldest residents (aged 81 and over) chose to walk around the lake than any of the other routes. More of these residents were classified as sufficiently active. Most of the residents walked around the lake more than one time. Around ten residents included route 1 as part of a longer walk on campus. These residents were younger and most were classified as highly active.

Figure 5.36: View of lake and cottages from path segments around the lake at PS

The reasons given by respondents for choose this route included attractive scenery (4 responses), convenience/ easy walking surface, safety and likelihood of meeting people.

Route 2: Route 2 (Figure 5.35) cut across campus from the back entrance all the way to the front entrance (gatehouse) (Figure 5.37), along the sidewalk by Bermuda Road (outside campus), and back into campus from the back entrance. This was the most challenging route – both in terms of overall length and the steep gradients that had to be overcome. There were no benches along this route except by the side of the lake. Also, a significant portion of the route lay outside the campus boundary. However, this was also an attractive route, and beautiful views of the campus and Stone Mountain could be seen from the sidewalks along Bermuda Road. The segments along this route were poorly integrated within the campus (less central) but were all high choice segments (lay on many routes). The total length of this route is 0.9 mile. Three respondents, none of whom reported health problems or used assistive devices, walked this route for recreation. Of these, two residents combined route 2 with other routes. The reasons given for choosing this route included the presence of uphill slopes and for exercise/distance covered.

Figure 5.37: View of road leading to gatehouse of PS campus

Route 3: This route made a loop around the Villa buildings and health center on one side and the lake on the other. It followed the sidewalks behind the 3000 building – to the main entrance of the clubhouse – around the health center – across the bridge – around the lake and up to the 3000 building (total length was approximately 0.7 mile) (Figure 5.35). This route was almost completely along sidewalks by the side of the road. Unlike route 2, this route was highly fragmented into smaller path segments and was quite irregular. Another variation of this route included walking up all the way to the back entrance of the campus – walking around the new construction and to the main clubhouse entrance. This corner of the campus was blocked off for construction during the study. Most of the segments along this route were less central, but high choice. Three residents chose to walk only this route and five residents walked this route (or minor variations of it) in combination with other routes. All the residents who walked this route were either sufficiently active or highly active. The reasons given by respondents for using this route included seeing variations in campus scenery (2 responses) and some uphill slopes in the route (exercise).

Route 4: Residents who took this route walked up the sidewalks in front of the cottages, weaving their way up the parallel paths and then walking back in the opposite direction. In one direction, this route is around 0.75 mile long (Figure 5.35). There were sidewalks all along this route passing in front of the resident cottages. The sidewalks were interrupted by the driveways leading to the cottages. Also, there were mailboxes blocking the sidewalks in front of the cottages (Figure 5.38). The segments along this route were less central within the layout and were all low choice segments. All the ten residents who walked along this route combined this with one of the other routes. Most residents who used this route were younger and either sufficiently active or highly active. The reasons given by respondents for using this route (in combination with others) included exercise or fitness (4 responses) and presence of uphill slopes to climb.

Figure 5.38: Mailboxes on sidewalk in front of cottages at PS

Route 5: This was a shorter loop inside the campus. The two residents who used this route – walked along the paths in the landscaped garden to the sidewalk bordering the Villa 2000 building, up to the clubhouse and back to their apartment. This is an attractive route through the landscaped garden (gazebo, waterfall) (Figure 5.39) and views of the lake could be obtained on the way to the clubhouse (Figure 5.35). Further, the segments within this route were all shallow within the network of path segments and many were high choice segments as well. One would expect that a walking route in the landscaped courtyard or through it very attractive. Surprisingly, this route was taken only by two residents. Possibly, the routes in the courtyard itself are too fragmented (made of short segments) for recreational walking and walking through the courtyard as part of a longer route involves either a detour or walking in and out of buildings, which may make it less convenient.

Figure 5.39: Gazebo in landscaped courtyard between building 2000 and 3000

Linear routes: This route did not make a loop. Some residents chose a certain path and then walked back along the same path (e.g. walking from the clubhouse to the greenhouse/garden and back). There is no single path that was selected for walking up and back. It usually depended on the where the resident lived. Only two residents walked up and back the same route (no loop). One of the residents who used this route had health problems that affected walking, though both were classified as highly active.

Indoor routes: We also notice two types of walking routes for indoor walks at PS. Four residents walked extensively along indoor paths in the Villa buildings and clubhouse. They walked the resident apartment corridors on each floor of each Villa building and on all floors of the clubhouse.

Thirteen residents walked on either all floors of one Villa building or back and forth along the corridor on a single floor. Some of the oldest residents (aged 81 or over) walked the shorter indoor route. In either case, we see that walking for recreation indoors involved using the corridors between the resident apartments.

The primary reason that residents gave for walking along the indoor routes was weather related – protection from rain or from heat.

5.6 Summary of PS Case Study

5.6.1 Path use for walking to destinations

The results show that more indoor path segments were used for walking to destinations on the PS campus. Clearly, the fact that the destinations are clustered in the clubhouse and that apartments residents have a convenient indoor route to the clubhouse may account for the fact that indoor path segments were preferred over outdoor path segments. Figure 5.40 shows the twenty path segments on the PS campus that were used most often for walking to destinations at PS. We see that path segments in the clubhouse (on the second floor and third floor) and the indoor connections between the clubhouse and Villa buildings were used a lot for walking to destinations. Indoor path segments were also used often. The statistical analysis shows that indoor path segments between resident apartments were used more often than other types (through public spaces, stairs etc.) of indoor path segments at PS.

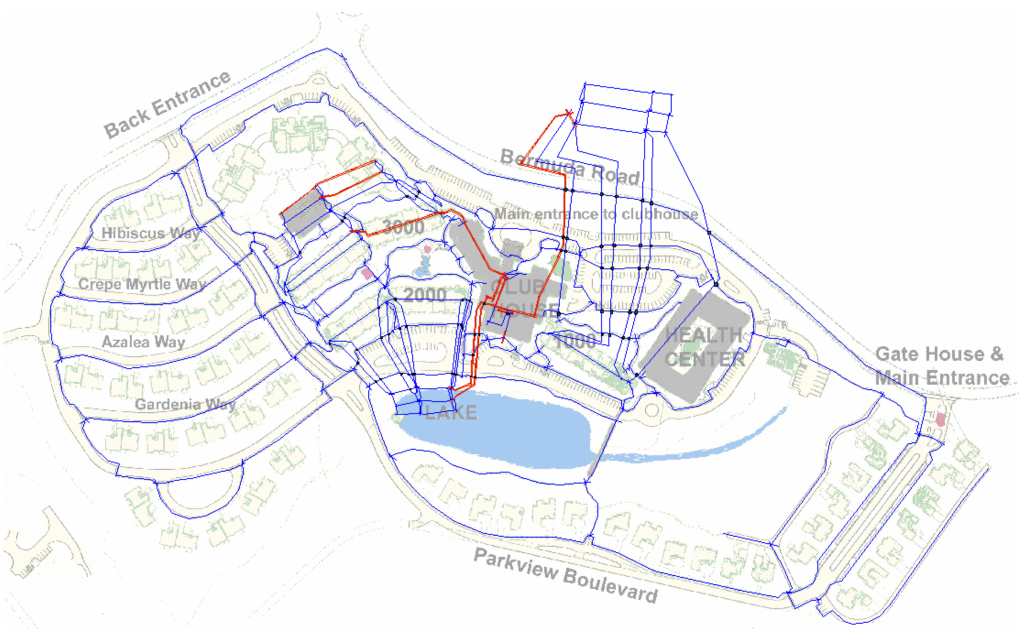


Figure 5.40: The 20 path segments at PS that were used most for walking to destinations (in red)

More path segments without steps were used for walking to destination on PS. This suggests that residents avoided using stair segments while walking to destinations, preferring to take the elevators wherever possible. The need for comfort while walking to meals was expressed often by residents during informal discussions. Many cottage residents mentioned that even though they walked extensively around campus for recreation, they often drove down to the clubhouse for their meals. The reason cited, especially by the women, was that they would be dressed in shoes and clothes that were not appropriate for walking across campus. All respondents used the dining room at least once in the last 7 days though as many as 3 of the cottage residents chose not to walk there (Table 5.37).

Table 5.37: Number of cottage and apartment residents that walked to destinations at PS

Type of residence	Destination – dining		Destination – activity related	
	Did not walk	Walked	Did not walk	Walked
Apartment	0	29	1	28
Cottage	3	6	1	8

The presence of destinations, especially activity related areas along path segments was related to their use for walking to destinations. For example, the path segment on the second floor of the clubhouse had many different destinations such as beauty salon, gift shop, mailroom and activity room along it and was used extensively by residents as they walked down to collect their mail. During informal observations, I noticed that many unplanned or spontaneous encounters occurred along this path. Residents stopped and talked with other residents or with staff members while walking down to one of the destinations down this path. All the activity related rooms along this corridor had glass walls and activities and people were visible as people walked down the corridor.

Path segments from which more types of views could be obtained were used no differently from path segments with none or few views overall and by most categories of residents. The only exceptions were cottage residents and apartment residents. More path segments with many views were used by cottage residents while the opposite was true for apartment residents. We see a similar contrast between apartment and cottage residents when we consider the relationship between specific views such as views of tended nature, untended nature and residential areas and path use for walking to destinations. These findings reflect the fact that walking to destinations is shaped a lot by the location of the individual's residence and the location of destinations relative to that. Thus, cottage residents needed to walk outdoors while apartment residents needed to walk indoors to get to destinations. The relation between path characteristics and path use is in most cases a reflection of the fact that people choose paths that are shortest and most convenient for getting to destinations.

Another factor that was related to path segments being used for walking to destinations is their location within the system of path segments on campus. The analysis shows that more path segments that were closer (central) to all other path segments on campus were used for walking to destinations. If we look at the distribution of path segments on the PS campus in terms of depth, we see that most of the central path segments were located at the center of the campus in the clubhouse building, the villa buildings, the connections between the clubhouse and the villa buildings and the outdoor path segments immediately bordering these buildings.

Also, a higher percentage of path segments that lay on many routes connecting two path segments on campus were used for walking to destinations as compared to path segments that lay on few routes connecting path segments at PS.

Some of the local environmental characteristics such as path material, path condition, path gradient, presence of street crossing in the segment and presence of path obstructions were not related to path use for walking to destinations. The presence of amenities was also not related to path use for walking to destinations. Sidewalk segments were used no differently from nature trails or road segments for walking to destinations.

5.6.2 Path use for walking for recreation

Local, relational and global environmental characteristics were related to path segments being used for recreation (Table 5.38). The analysis shows that more outdoor path segments were used for recreation as compared to indoor path segments. However, it is interesting to note that many of the indoor path segments, especially path segments between resident apartments (Figure 5.2) were used for recreational walking. In fact, in an interview, the developer of the community mentioned that many residents were walking up and down the corridors between apartments for exercise and the noise was disturbing to some of the other residents. They are planning to build a continuous glass-covered indoor walking route around the new fitness center for residents who like walking indoors so as to reduce the corridor walking. The developer's observation was also shown to be true statistically – indoor path segments between resident apartments were used more often for recreational walking as compared to other types of indoor path segments.

There is a highly significant relationship between the length of segments and their use for walking for recreation. A higher percentage of long path segments were chosen for recreational walking and this was true for all categories of residents. Among outdoor path segments, more sidewalk segments along the side of the road were used than other types of outdoor path segments (such as nature trails and road segments). This may also be related to the finding that path segments with parking destinations were used for recreation. Most of the parking areas are located along the perimeter of the campus and there are sidewalks leading from the parking areas to the clubhouse and villa buildings.

Path segments without steps were used more often for walking for recreation as compared to path segments with steps. Indoor path segments with steps tended to be stairs. The outdoor path segments with steps were attractive path segments with wonderful views of the campus. However, these are long segments with steps and there are no benches or places to rest along the way, which may explain their low usage.

A higher percentage of continuous path segments were used for walking for recreation as compared to disjointed path segments. This was not surprising given that most of the disjointed path segments could not be easily incorporated into a continuous walking route.

The presence of destinations is related to path segments being used for recreation as well. Specifically, people tended to walk for recreation along path segments with residential destinations. The likelihood of meeting other people and also the perception of being visible by the other people may be a factor related to these path segments being used for walking.

The number of views that can be seen from a path appears to matter though the presence of any specific view was not related to path use for recreational walking.

There is a relationship between depth of the path segment and its use. A higher percentage of more central path segments were used for recreational walking, though this is only marginally significant and not true for all categories of residents. The second global environmental variable – choice – is also related to path use for recreation. More path segments with higher choice (lie on many routes) were used for recreational walking as compared to path segment with low choice.

Table 5.38: Local, relational and global path characteristics are related to path use for getting to destinations and for recreation at PS.

Path characteristics	Path use for getting to destinations	Path use for walking for recreation
Local Environmental characteristics		
Path Type: Does path type matter?	Yes: More internal path segments tend to be used as compared to external path segments. Not true overall and for all resident categories.	Yes: More external path segments tend to be used as compared to internal path segments. Opposite is true for path use by insufficiently active residents.
Path length: Are longer path segments used for walking more than short path segments?	No difference between long and short path segments.	Yes. Longer path segments tend to be used as compared to short path segments. This is true for overall path use and path use by resident categories.
Location of internal path segments: Is the location of internal path segments related to their use for walking?	Yes. More path segments between resident apartments are used as compared to other types of internal path segments. Opposite is true for cottage residents.	Yes. More path segments between resident apartments are used as compared to other types of internal path segments.
Location of external path segments: Is the location of external path segments related to their use for walking?	No	Yes. More sidewalk path segments were used as compared to other types of outdoor path segments.
Path material of outdoor path segments: Does path material matter?	No	No
Path material of indoor path segments: Does path material matter?	No	No
Path slope: Does path segment (slope) matter?	No	No
Path condition: Are more path segments in good condition used for walking?	Variable excluded – insufficient variation	
Presence of street crossing: Are path segments with street crossings used less?	No difference	Opposite is true.
Presence of path obstruction: Are fewer path segments with obstructions used for	No difference	No difference

Table 5.38: Local, relational and global path characteristics are related to path use for getting to destinations and for recreation at PS.

walking?		
Presence of steps: Are more path segments without steps used for walking?	Yes. The relationship is marginally significant and is true for overall path use and path use by three resident categories	Yes.
Path continuity: Are more direct path segments used for walking as compared to disjointed routes?	Yes.	Yes.
Amenities: Are more path segments with amenities (benches, trashcans, handrails, etc) used for walking?	No difference.	The opposite relationship is true: more path segments *without* amenities were used for recreation.
Destinations: 1. Are more path segments with one or more destinations used for walking as compared to path segments without any destination? **2.** Is the presence of specific destinations related path use?	1. Yes 2. More path segments with *activity related areas* were used for walking to destinations	1. Yes 2. More path segments with *residential areas* and *parking areas* along them were used for walking. Residents using assistive devices used path segments with natural destinations along them.
Relational Path characteristics		
Views: 1. Are path segments from which many different types of views are seen used for walking as compared to path segments with none or few views? 2. If a particular type of view (e.g. view of water) can be seen from a path does it tend to be used more often?	1. No difference between path segments with different number of views (except for cottage and apartment residents) 2. More path segments with views of water (lake), public spaces or art were used. Fewer path segments with views of residential areas, tended nature, untended nature were used.	1. Yes. The relationship is marginally significant for overall path use and for three categories of residents. 2. No difference in path use for recreations between path segments with and without specific views.
Global Path Characteristics		
Average Distance: Are more shallow path	Yes.	Yes.

Table 5.38: Local, relational and global path characteristics are related to path use for getting to destinations and for recreation at PS.

segments used for walking as compared to deeper path segments?		
Choice: Are path segments that lie on many routes on campus used for walking more than path segments that lie on few routes on campus?	Yes	Yes.

The analysis of the data obtained from PS begins to suggest that a variety of factors may be related to path choice for walking. Some of these factors were local – that is characteristics of the path itself, such as the length of the segments. Types of views and number of views from the path segment were relational path characteristics that may be related to walking. The centrality of a path segment and choice within the network of path segments on campus were global structural path characteristics that are related to instrumental and recreational walking (Table 5.38).

However, the analysis above begins to suggest that some of these environmental characteristics may also be linked to each other. Many of the long path segments were also outdoor path segments. Resident apartments and cottages at PS were for the most part located along long path segments. Thus, even though there appears to be a strong relationship between the length of path segments and their use for walking for recreation, it is not entirely clear whether length is main factor or some other factor that is related to path use. Or perhaps it is a combination of these factors that is related to path use. This is probably a more realistic finding because in real life situations, environmental factors are never isolated – path segments may be long, be well maintained, be indoor or outdoors and so on. The findings from PS begin to create a picture of some of the characteristics of path segments that may be important to consider together while designing environments for walking.

The location of destinations and the location of the residence with respect to the destination is probably a key factor that explains a lot of findings in terms of path use for walking to destinations. For example, we find that more path segments between resident apartments are used for walking to destinations by the different categories of residents. However, the opposite is true for cottage residents – they used all other types of internal path segments more than path segments between resident apartments. This is clearly because the most convenient routes from the cottages to the destinations in the clubhouse are along path segments leading directly to the clubhouse. They do not need to walk along corridors in the Villa buildings to get to their destinations.

Some key findings from the analysis of path segments and routes for recreational walking include:

- Longer path segments were used for recreation. We also see from the analysis of the most commonly used routes that most of these routes (indoor and outdoor) were made of long segments.
- Commonly used routes (except route 4) were made up of high choice segments.
- There was a preference for looped outdoor walking routes. Only two recreational routes did not form loops.
- Four distinct looped routes were observed at PS. Some residents used a combination of these loops to complete their route.
- These loops appear to be structured in terms of increasing levels of difficulty – the loop around the lake was the easiest and the loop around the campus was the most challenging.

- The route around the lake was the most popular– it was used on its own as well as part of longer routes.
- The popularity of the lake route may be attributed to its overall loop structure as well as the characteristics of the segments that comprise it. The segments tend to be – shallow, high choice, long, with many types of views, with no steps or obstructions.
- Indoor walking along resident apartment corridors was very popular at PS.
- Indoor routes varied between challenging (all floors all buildings) to easy (back and forth on same floor).
- More of the oldest residents (aged 81 and over) and sufficiently active residents used the route around the lake for recreational walking.
- Insufficiently active residents preferred indoor routes for recreational walking
- Residents who chose the most challenging routes or combination of routes tended to be younger, did not use assistive devices or experience health problems and were either sufficiently active or highly active.

CHAPTER 6

CASE STUDY 2: LV RETIREMENT COMMUNITY

6.1 Survey Respondent Characteristics and Path Use Characteristics

6.1.1 Survey respondent characteristics

Forty residents responded to the survey (11% response rate). The characteristics of the survey respondents were as follows (Table 6.1):

Table 6.1: Characteristics of LV survey respondents

Respondent characteristics		**Overall**		**Male**		**Female**	
		N	%	N	%	N	%
Age	72 years or less	9	23	4	21	5	24
	73-80 years	15	37	8	42	7	33
	81 years and over	14	35	7	37	7	33
Gender	Male	19	47	19	100		
	Female	21	53			21	
Type of residence	Apartment	35	87	16	84	19	90
	Cottage	5	13	3	16	2	10
Length of stay at community	Less than 6 months	4	10	3	16	1	5
	6 months to one year	2	5	1	5	1	5
	One to three years	15	37	6	32	9	43
	Three to five years	19	48	9	47	10	47
	More than five years	0	0	0	0	0	0
Use assistive device for walking?	No	37	93	18	95	19	90
	Yes	3	7	1	5	2	10
Experienced health problems recently that affected walking	No	29	73	13	68	16	76
	Yes	11	27	6	32	5	24
Physical activity level (based on IPAQ)	Insufficiently active	5	13	3	16	2	10
	Sufficiently active	9	23	2	11	7	33
	Highly active	23	57	13	68	10	47
	Cases excluded	3	7	1	5	2	10

A majority of the respondents were below 80 years of age (63%) with a range between 63 and 91. The median age of the respondents in the sample was 78 and the average age was 77 years. There were more women in the sample (53%), though the sample was almost evenly divided. Most of the residents (87%) had lived on campus more than one year and 47% had live three to five years on campus at the time of the study. Eighty seven percent of the respondents lived in apartments (Table 6.1). If we consider the campus wide distribution of residents at LV based on type of residents, we also see that 87% of the residents live in apartments. Only 7% of the respondents used assistive devices for walking. A little more than a quarter of the sample (27%) reported that they had experienced health problems in the last 6 months that affected their walking. A majority of the respondents were categorized as highly active (57%) based on their responses to the IPAQ questionnaire.

6.1.2 Path use characteristics

<u>Path use for walking to destinations</u>

Path use for walking to destinations was measured by how many times the path segment was selected by all respondents during two trips to two different destinations on campus in the last 7 days. A majority of the segments (72%) were not used at all by the respondents during the course of two trips taken to two different destinations in the last 7 days. Most path segments tended to be chosen 6 or fewer times (90%). Less than 5% of path segments were chosen 20 or more times (maximum: 64 times) for walking to destinations (Table B.3).

Figure 6.1 shows the path segments (in red) that were used by all respondents during one walking trip each to two different destinations on LV in the last seven days. Indoor path segments (location of indoor and outdoor path segments can be seen in Figure 6.3), especially on the 4^{th} floor (main floor) were used the most. Some outdoor path segments leading from the cottages to the clubhouse or residential buildings were also used.

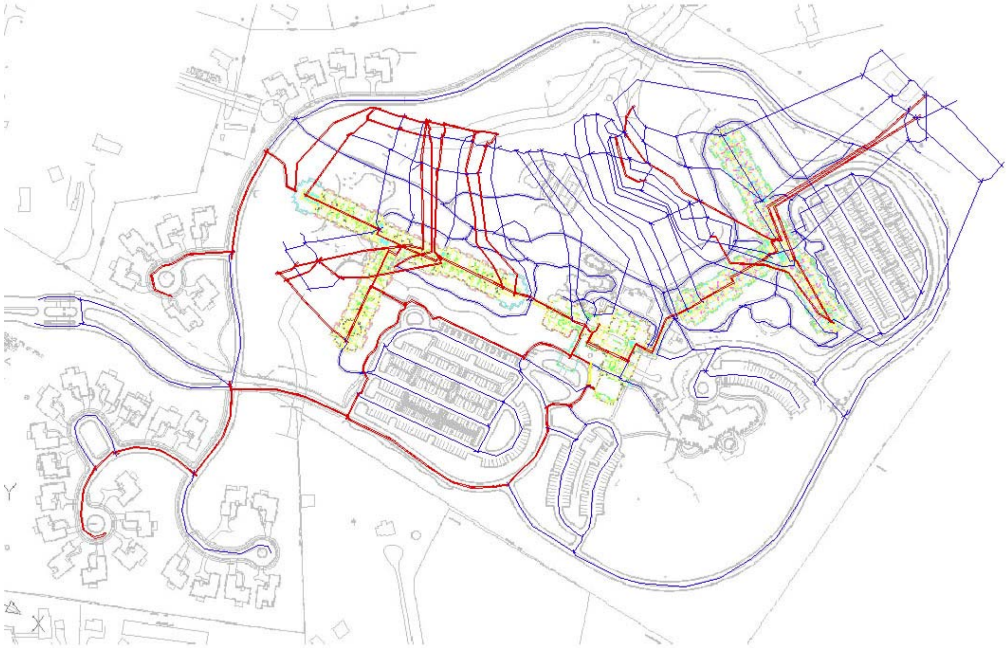


Figure 6.1: Path segments in red were used for walking to destinations on LV

Path use walking for recreation

Path use for recreational walking was measured by the number of times the path segment was chosen by respondents during the course of their last recreational trip (indoor and outdoors) on campus in the last seven days. Only 22% of the path segments were not used at all by any of the respondents at LV for recreational walking. Forty percent of all path segments on campus were used 1-5 times. Five percent of the path segments were chosen very often (20 or more times) during recreational walking trips on the LV campus (Table B.4 in Appendix).

Figure 6.2 shows that a majority of the path segments on campus were used for recreational walking (in red). Eighty-seven percent of outdoor path segments and 72% of the indoor path segments had some use for recreation. The path segments that were not used at all are primarily the stair segments connecting different floors on campus.

Figure 6.2: Path segments in red were used for walking for recreation on the LV campus

Since the purpose of this study is to understand which aspects of path segments are related to their use for walking, it is useful to classify path segments into different categories based on use. This allows us to compare the characteristics of path segments in different use categories. For the most interpretable results path segments were classified into 2 categories – those that were not chosen at all for walking (no use) versus those that were chosen once or more for walking (use).

As described in the earlier chapter, it is likely that different groups of residents (e.g. those with health problems, those in the highly active category) may differ from the overall group in terms of path use. The table below (Table 6.2) summarizes path use (no use versus some use) by different types of residents for instrumental walking and recreational walking.

Table 6.2: Path use for walking among different categories of residents

Path use for ….		**Getting to destinations**				**Walking for recreation**			
		Path segments that were not used at all		**Path segments that had some use**		**Path segments that were not used at all**		**Path segments that had some use**	
		N	%	N	%	N	%	N	%
Overall (n=40)		199	72	76	28	60	22	215	78
Gender	Males (n=19)	214	78	61	22	92	33	183	67
	Females (n=21)	218	79	57	21	108	39	167	61
Use of assistive device?	Yes (n=3)	259	94	16	6	264	96	11	4
	No (n=37)	202	73	73	27	62	23	213	77
Reported health problems in the last six months that affected walking?	Yes (n=11)	241	88	34	12	165	60	110	40
	No (n=29)	209	76	66	24	70	25	205	75
Age	Below 72 (n=9)	227	83	48	17	109	40	166	60
	Between 73 and 80 (n=15)	236	86	39	14	144	52	131	48
	81 and over (n=14)	232	84	43	16	133	48	142	52
Activity Category	Insufficiently active (n=5)	266	97	9	3	260	95	15	5
	Sufficiently active (n=9)	239	87	36	13	165	60	110	40
	Highly active (n=24)	206	75	69	25	75	27	200	73
Type of residence	Cottage (n=5)	240	87	35	13	202	73	73	27
	Apartment (n=35)	102	37	173	63	63	23	212	77

It is difficult to make comparisons within this table since the number of respondents in each category (e.g those using assistive devices versus those not using assistive devices) varies. The sample is almost equally divided in terms of age and gender. We see that path usage for recreational and instrumental walking is similar between men and women. Also, there seems to be little difference between residents of different ages in terms of the number of path segments they use for getting to destinations on campus. Apartment residents use a higher percentage of path segments (63%) for getting to destinations than any other sub category of residents.

6.2 Environmental factors that may be related to path segment use

The environmental factors that are examined in this section include:

Local characteristics:

- Type of path segment – indoor path or outdoor path
- Length of path segment
- Location of path segment – for indoor and outdoor path segments
- Path material – indoor and outdoor path segments
- Path gradient
- Presence of street crossing in segment
- Presence of path obstruction
- Presence of steps
- Path continuity
- Number of amenities present
- Presence of destinations on path segment
- Number of destinations along path segment

Relational characteristics

- Presence of specific views from path segment
- Number of views from path segment

Global Characteristics

- Average distance from all other path segments on campus
- The number of routes that a path segment lies on

The following section examines whether path segments that were used for walking (for recreation or getting to destinations) differ from path segments that were not used at all in terms of these environmental path characteristics.

6.2.1 Local Path Characteristics

6.2.1.1 Path Type

Outdoor path segments constituted around 45% of all path segments on campus. The figure below (Figure 6.3) indicates the indoor (blue) and outdoor path segments on campus. Indoor path segments included stairs, path segments through the clubhouse as well as path segments between resident apartments on the different floors

Figure 6.3: Path segments in blue are indoor path segments within buildings and path segments in red are outdoor path segments

Research Question: Do indoor/outdoor path segments tend to be used differently for getting to destinations or for recreation

Path use for getting to destinations

Results: Overall, when all respondents were considered, there was a difference between indoor and outdoor path segments in terms of their use for getting to destinations. When specific categories of residents were considered many significant relationships were observed (Table 6.3). The relationship between the type of path and its use for walking to destinations was highly significant for male residents, residents using assistive devices, residents reporting health problems, insufficiently active residents, sufficiently active residents and resident aged 73 to 80 years. These residents used more indoor path segments over outdoor path segments for walking to destinations. For example, residents reporting health problems used 22% of indoor path segments for getting to destinations while they used none of outdoor path segments. There is no difference in use of indoor and outdoor path segments among female residents, those not reporting health problems and those below 72 years ($p > 0.05$).

It is also interesting to note that unlike all other categories of residents, cottage residents used outdoor path segments more often than indoor path segments while walking to destinations. This is related to the fact that the cottages are not physically connected to the clubhouse building, requiring cottage residents to use outdoor path segments.

Table 6.3: More indoor path segments were used for getting to destinations on LV as compared to outdoor path segments

Segment use for getting to destinations by…	Use category	Indoor path segments	Outdoor path segments	Chi-square	p-value
Overall	No use Some use	65% 35%	81% 19%	8.88	.003
Men	No use Some use	70% 30%	88% 12%	12.8	.000
Residents using assistive device	No use Some use	90% 10%	100% 0%	13.7	.000
Residents not using assistive devices	No use Some use	67% 33%	81% 19%	7.0	.008
Residents with health problems	No use Some use	78% 22%	100% 0%	31.4	.000

Table 6.3: More indoor path segments were used for getting to destinations on LV as compared to outdoor path segments

Residents aged 73 to 80 years	No use Some use	76% 24%	98% 2%	25.2	.000
Residents 81 years or over	No use Some use	80% 20%	90% 10%	5.8	.016
Insufficiently active residents	No use Some use	94% 6%	100% 0%	7.5	.006
Sufficiently active residents	No use Some use	78% 22%	98% 2%	22.2	.000
High active residents	No use Some use	70% 30%	81% 19%	4.8	.028
Cottage residents	No use Some use	91% 9%	82% 18%	5.3	.021
Apartment residents	No use Some use	32% 68%	44% 56%	4.4	.035

<u>*Path use for walking for recreation*</u>

Results: Overall, more outdoor path segments were used for recreational walking as compared to indoor path segments (Table 6.4). Eighty-six percent of all outdoor path segments were chosen for recreational walking at LV while only 72% of indoor path segments were chosen. Also, a larger percentage of indoor path segments (28%) as compared to outdoor path segments (14%) were not used at all for recreational walking.

When subcategories of residents were considered the same holds true – more outdoor path segments were used for recreational walking by different types of residents: male, residents not using assistive devices, with and without health problems, insufficiently active residents, highly active, residents between 73 and 80, residents aged 81 and over, apartment and cottage residents. Unlike other categories of residents, cottage residents did not use any of the indoor path segments for recreational walking. There was no difference in use of indoor and outdoor path segments for recreation among residents who are female, residents using assistive devices, residents 72 years or below and residents who are sufficiently active.

Table 6.4: More outdoor path segments were used for walking for recreation as compared to indoor path segments

Segment use for walking for recreation by…	Use category	Indoor path segments	Outdoor path segments	Chi-square	p-value
Overall	No use Some use	28% 72%	14% 86%	8.3	.004
Men	No use Some use	45% 55%	19% 81%	21.7	.000
Residents not using any assistive device	No use Some use	29% 71%	15% 85%	7.9	.005
Residents with health problems	No use Some use	72% 28%	45% 55%	21.6	.000
Residents with no health problems	No use Some use	32% 68%	17% 83%	8.2	.004
Residents aged 73 to 80 years	No use Some use	72% 28%	28% 72%	54.5	.000
Residents aged 81 and over	No use Some use	61% 39%	33% 67%	22.4	.000
Insufficiently active residents	No use Some use	97% 3%	91% 9%	5.2	.022
Highly active residents	No use Some use	35% 65%	18% 82%	9.8	.002
Cottage residents	No use Some use	100% 0%	41% 59%	122.8	.000
Apartment residents	No use Some use	28% 72%	16% 84%	5.5	.018

6.2.1.2 Length of Path Segment

The table below (Table 6.5) shows the distribution of path segments on campus by path length (in feet). Thirty-four percent of all path segments were less than 50 feet. Less than 4% of the path segments are really long (over 400 feet.)

Table 6.5: Distribution of path segments by length

Length of path segment	Number of path segments	Percent	Cumulative Percent
less than 50'	94	34.6	34.6
51' to 100'	67	24.6	59.2
101' to 150'	27	9.9	69.1
151' to 200'	29	10.7	79.8
201' to 250'	16	5.9	85.7
251' to 300'	8	2.9	88.6
301' to 350'	10	3.7	92.3
351' to 400'	6	2.2	94.5
401' to 450'	5	1.8	96.3
451' to 500'	6	2.2	98.5
over 500'	4	1.5	100.0
Total	272	100.0	

For the purpose of analysis path segments were classified as short (less than 50 feet) or not short/long (51 feet or over). Shorter path segments make up 34.3% of all segments on the LV campus. 83% of shorter path segments were located indoors at PV. Figure 6.4 shows the distribution of path segments in terms of length. Sixty percent of the longer path segments were outdoor path segments. The vertical connections between floors (stairs) were the shorter segments at LV.

Figure 6.4: Sixty percent of the longer path segments (in red) are located outside buildings on the LV campus

Research Question: Is the length of a path segment related to its being chosen for getting to destinations or for recreation?

<u>Path use for getting to destinations</u>

Results: The length of the segment was not related to its use for walking to destinations ($p=0.26$). That is, shorter path segments were no more likely to be used than longer path segments for getting to destinations. This is true, even when all resident level outcome variables were considered ($p>=0.15$ for path use by all resident subcategories).

Path use for recreational walking

Results: The length of the segment was related to walking for recreation. A higher percentage of longer path segments were chosen over shorter path segments for walking for recreation. The table below (Table 6.7) shows the association between path use and path length for all residents and all subcategories of residents. Overall, around 84% of all long path segments on campus were chosen for walking to destinations, while only 65% of short path segments were chosen.

This is also true for path use for recreation by most resident categories (Table 6.6). The only exceptions are path use by residents using assistive devices (p=0.6), residents reporting health problems (p=0.2), residents over 81 years (p=0.06) and sufficiently active residents (p=0.5).

Table 6.6: A higher percentage of long path segments were used for recreational walking as compared to short path segments

Segment use for walking for recreation by…	Use category	Short path segments	Long path segments	Chi-square	p-value
Overall	No use Some use	35% 65%	16% 84%	14.6	.000
Male	No use Some use	52% 48%	24% 76%	22.1	.000
Female	No use Some use	49% 51%	34% 66%	5.4	.02
Residents not using any assistive device	No use Some use	36% 64%	16% 84%	14.9	.000
Residents with no health problems	No use Some use	42% 58%	17% 83%	19.1	.000
Residents aged below 72 years	No use Some use	57% 43%	30% 70%	19.4	.000
Residents between 73 to 80 years	No use Some use	68% 32%	44% 56%	13.8	.000
Insufficiently active residents	No use Some use	99% 1%	92% 8%	5.3	.02
Highly active residents	No use Some use	43% 57%	19% 81%	16.6	.000
Cottage residents	No use Some use	96% 4%	62% 38%	36.6	.000
Apartment residents	No use Some use	35% 65%	17% 83%	11.8	.001

6.2.1.3 Location of indoor path segments

Indoor path segments at LV were one of the following:

1. Path segments between resident apartments
2. Path segments through public spaces
3. Connections between buildings
4. Indoor staircases

When these different types of indoor path segments were compared it was evident that the difference in path use lay between path segments between resident apartment and other types of indoor path segments. For the purpose of analysis, path segments were organized into two categories – between resident apartments and other types of indoor path segments.

Table 6.7: Distribution of path segments by location inside buildings

Location of indoor path segments	Number of path segments	Percent
Path between resident apartments	63	41.4
Path through public spaces	36	23.7
Connection between buildings	6	3.9
stair	47	30.9
Total	152	100.0
Outdoor path segments	123	
Total	275	

Research Question: Are different types of indoor path segments (located in different places) used differently for walking for recreation/ getting to destinations?

Path use for getting to destinations

Results: The location of indoor path segments was not related to their use for walking to destinations at LV (p=0.74). Path segments between resident apartments were not used any differently from other types of indoor path segments even when path use by different categories of residents was considered (p>0.2), with the exception of path use by apartment residents. They used 86% of the indoor path segments between resident apartments and 56% of the other indoor path segments (p=0.000).

Path use for walking for recreation

The location of indoor path segments appears to be related to walking for recreation. Eighty-nine percent of the path segments located between resident apartments were used for recreational walking while only 60% of all other indoor path segments were used (Table 6.9). This was found to be true for path use by most categories of residents. The relationship was not significant when path use by the following categories of residents was considered: residents using assistive devices (p=0.14), residents with health problems (p=0.9), residents between 73 and 80 (p=0.6), residents aged 81 and over (p=0.4), insufficiently active residents (p=0.75) and sufficiently active residents (p=0.23). Cottage residents did not use any of the indoor path segments for recreational walking at LV.

Table 6.8: Relationship between location of indoor path segments and path use for recreation

Segment use for walking for recreation…	Use category	Indoor path segments between resident apartments	All other indoor path segments	Chi-square	p-value
Overall	No use Some use	11% 89%	40% 60%	15.6	.000
Men	No use Some use	25%	16%	17.3	.000
Female	No use Some use	27% 73%	51% 49%	8.5	.004
Residents not using assistive devices	No use Some use	11% 89%	42% 58%	16.6	.000
Residents without health problems	No use Some use	11% 89%	47% 53%	21.9	.000
Residents aged 72 or less	No use Some use	18% 82%	58% 42%	25.5	.000
High active residents	No use Some use	16% 84%	48% 52%	17.1	.000
Apartment residents	No use Some use	11% 89%	40% 60%	15.6	.000

6.2.1.4 Location of outdoor path segments

There were six main types of outdoor path segments on campus:

1. Sidewalk next to road
2. Sidewalk within 1m of curb
3. Shared path no markings
4. Path trail through landscaped green area
5. Access lane
6. Road crossover

Sidewalks and path segments/trails though parks were the two main types of outdoor path segments on campus. When the different types of outdoor path segments were compared, differences in path use were identified between two main groups - path segments/trails through landscaped green areas and other types of outdoor path segments. Thus, outdoor path segments were classified into two main categories – path/trails through landscaped green areas and all other types of outdoor path segments. The former constitutes 37.4% of all outdoor path segments on the LV campus.

Figure 6.5: The nature path segments/trails (red) are mostly located in the landscaped area to the north of the residential buildings and clubhouse

Figure 6.5 shows the distribution of outdoor path segments on campus in terms of their location. The path segments in red are the nature trails and path segments through landscaped areas on campus. Most of the nature trails were located in the landscaped garden to the north of the campus, behind the residential buildings and clubhouse. The path segments were located on the gently sloping parts of the site close to the buildings. The site falls away sharply to the north of the trails.

Research Question: Is the location of outdoor path segments related to their use for walking for recreation/ getting to destinations?

Path use for getting to destinations:

Results: Location of outdoor segments was related to their use for getting to destinations. Fewer path segments/trails through parks or green areas were used as compared to all other types of outdoor path segments (road segments, sidewalks) (Table 6.11). This relationship is true overall and for the categories of residents listed in the table below. Residents categorized as insufficiently active, residents aged 81 years and above, those using assistive devices and those with health problems did not use any of the outdoor path segments for walking to destinations. The location of outdoor path segments was not related to path use by sufficiently active residents (p=0.88) and apartment residents (p=0.23).

Table 6.9: All other types of outdoor segments were used more for getting to destinations as compared to path segments/trails through nature.

Segment use for walking to destination by…	Use category	All other outdoor path segments	Path segments that are path segments/trails through parks	Chi-square	p-value
Overall	No use Some use	71% 29%	98% 2%	17.2	.000
Male	No use Some use	82% 8%	98% 2%	6.9	.009
Female	No use Some use	75% 25%	98% 2%	10.7	.001
Residents not using any assistive device	No use Some use	71% 29%	98% 2%	13.2	.000
Residents with no health problems	No use Some use	71% 29%	98% 2%	13.2	.000
Residents aged below 72 years	No use Some use	78% 22%	100% 0%	11.7	.001
Residents between 73 to 80 years	No use Some use	84% 16%	100% 0%	7.9	.005
Highly active residents	No use Some use	71% 29%	98% 2%	13.2	.000
Cottage residents	No use Some use	73% 27%	98% 2%	12.3	.000

<u>Path use for recreational walking</u>

Results: Fewer path segments/trails through parks were used for recreation (76%) as compared to all other types of outdoor path segments (93%). The relationship was significant for most categories of residents. Path segments/trails through parks were used no differently from all other outdoor segments by the following categories of residents: female residents (p=0.2), residents using assistive devices (p=0.45) and sufficiently active residents (p=0.8).

Table 6.10: Fewer paths/trails through landscaped areas were used for recreational walking as compared to all other types of outdoor path segments

Segment use for walking for recreation by…	Use category	All other outdoor path segments	Path segments/trails through parks	Chi-square	p-value
Overall	No use Some use	7% 93%	24% 76%	7.7	.005
Male	No use Some use	8% 92%	35% 65%	14.3	.000
Residents not using any assistive device	No use Some use	7% 93%	26% 74%	9.3	.002
Residents with health problems	No use Some use	36% 64%	57% 43%	4.7	.029
Residents without health problems	No use Some use	9% 91%	28% 72%	7.7	.005
Residents aged below 72 years	No use Some use	27% 73%	52% 48%	7.7	.006
Residents between 73 to 80 years	No use Some use	20% 80%	37% 63%	5.6	.017
Residents aged 81 and over	No use Some use	22% 78%	48% 52%	8.8	.003
Insufficiently active residents	No use Some use	86% 14%	100% 0%	7.2	.007
Highly active residents	No use Some use	9% 91%	30% 70%	9.2	.002
Cottage residents	No use Some use	20% 80%	74% 26%	35.6	.000
Apartment residents	No use Some use	10% 90%	24% 76%	4.0	.045

6.2.1.5 Path Material – Outdoor path segments

Forty seven percent of the outdoor path segments on campus were made of continuous concrete and 48% of bitumen. A small number of path segments (4%) were made of paving bricks (road crossovers).

Research Question: Is the material of which outdoor path segments are constructed related to their use for walking to destinations/walking for recreation?

Path use for getting to destinations

Results: Path material of outdoor path segments was not related to their use for walking to destinations ($p=0.6$). This was true even when path use by all categories of residents was taken into consideration ($p>0.3$ for all categories).

Path use for recreational walking

Comparison between the path segments made of different types of outdoor materials showed that the main difference in path use for recreation at LV lay between outdoor path segments made of bitumen and all other outdoor path segments. Thus, this variable was collapsed into these two categories.

More path segments made of bitumen were used for walking for recreation as compared to other types of outdoor path segments. When all residents are considered, as many as 97% of all outdoor path segments made of bitumen (road segments) were used for recreation as compared to 78% of outdoor path segments made of other types of materials (Table 6.11). This relationship remains true even when path use by different categories of residents is considered. Bitumen path segments are used no differently from outdoor path segments made of other materials when path use by – female residents ($p=0.3$), residents using assistive devices ($p=0.3$), residents with health problems ($p=0.08$) and sufficiently active residents ($p=0.3$) - was considered.

Table 6.11: More outdoor bitumen path segments were used as compared to other types of outdoor path segments.

Segment use for walking for recreation by…	Use category	Bitumen path segments	Outdoor path segments made of other materials	Chi-square	p-value
Overall	No use Some use	3% 97%	22% 78%	9.2	.002
Male	No use Some use	5% 95%	30% 70%	12.6	.000
Residents not using any assistive device	No use Some use	3% 97%	23% 77%	10.3	.001
Residents without health problems	No use Some use	7% 93%	25% 75%	7.5	.006
Residents aged below 72 years	No use Some use	20% 80%	52% 48%	12.9	.000
Residents between 73 to 80 years	No use Some use	15% 85%	38% 62%	7.7	.005
Residents aged 81 and over	No use Some use	22% 78%	41% 59%	4.9	.027
Insufficiently active residents	No use Some use	83% 17%	98% 2%	8.9	.005
Highly active residents	No use Some use	3% 97%	30% 70%	14.9	.000
Cottage residents	No use Some use	10% 90%	67% 33%	41.6	.000
Apartment residents	No use Some use	9% 81%	22% 78%	4.2	.04

6.2.1.6 Path Material – Indoor path segments

All indoor path segments were carpeted. Since there was no variation, this variable was excluded from the analysis.

6.2.1.7 Path gradient

Since all indoor path segments were flat, only outdoor path segments were considered for the analysis. Sixty five percent of all outdoor path segments at LV were flat, 23% had moderate slope and 12% were steep. As mentioned earlier in Chapter 4, the LV campus is located on a site with dramatic grade changes.

Figure 6.6: Distribution of path segments on campus based on gradient – flat or gentle slope (red), moderate slope (pink), steep slope (blue)

Research Question: Is path gradient of outdoor path segments related to use of path segments for walking for recreation/ getting to destinations?

Path use for getting to destinations

Results: Path gradient was not related to use of path segments for walking to destinations at LV (p=0.7). Flat, moderately sloping and steep path segments were used no differently even when path use by different resident categories was considered (p>0.2), with the exception of path use by apartment residents (p=0.028). Apartment residents used 48% of the flat outdoor path segments, 75% of moderately sloping path segments and 67% of steep path segments for getting to destinations. This finding is somewhat difficult to explain as apartment residents did not need to use outdoor path segments for walking to destinations on campus.

Path use for recreational walking

When responses from all residents was considered, there was no relationship between paths of different slopes and path use for recreational walking (p=0.13). However, when we considered path use by resident categories some significant relationships were observed. The key difference in path use was observed between path segments that were flat and path segments that were moderately sloping or steep. Thus, path gradient was collapsed into these two categories.

More moderately sloping or steep path segments were used for recreational walking as compared to flat segments (Table 6.12). This was also true for path use by most resident categories. The relationship was not significant for path use by residents using assistive devices (p=0.4), residents with health problems (p=0.7), sufficiently active residents (p=0.065), highly active residents (p=0.2) and cottage residents (p=0.11).

Table 6.12: More moderately sloping or steep path segments were used for recreational walking as compared to flat path segments.

Segment use for walking for recreation by…	Use category	Flat path segments (%)	Moderately sloping or steep path segments (%)	Chi-square	p-value
Overall	No use Some use	18 82	5 95	4.1	.043
Male	No use Some use	25 75	5 95	7.8	.005
Female	No use Some use	44 56	23 77	5.1	.024
Residents not using any assistive devices	No use Some use	19 81	5 95	4.7	.031
Residents without health problems	No use Some use	23 77	5 95	6.5	.011
Residents aged below 72 years	No use Some use	44 56	23 77	5.0	.024
Residents between 73 to 80 years	No use Some use	35 65	12 88	7.8	.005
Residents aged 81 and over	No use Some use	39 61	19 81	5.2	.022
Insufficiently active residents	No use Some use	95 5	84 16	4.4	.037
Apartment residents	No use Some use	21 79	5 95	5.9	.015

6.2.1.8 Path condition

Since there was insufficient variation between categories- 95% are in good condition - this variable was excluded from the analysis.

6.2.1.9 Presence of street crossing in segment

Only eight percent of all path segments on campus have street crossings in them.

Research Question: Is the presence of a street crossing within the segment related to its use for walking for recreation/ getting to destinations?

Results: The presence of a street crossing within a path segment was not related to its use for walking for recreation ($p=0.2$) or walking to get to destinations at LV ($p=0.1$).This was true even when path use by subcategories of residents was considered (for recreational walking $p>0.1$; for instrumental walking $p>0.1$ for all resident categories).

6.2.1.10 Presence of path obstructions in segment

Since there were very few path segments with path obstructions in them (2.5%), there was insufficient variation in this variable to conduct analysis. Thus, this variable was excluded.

6.2.1.11 Presence of steps in the segment

Twenty-three percent of all path segments on the LV campus had steps in them. Almost all these segments (99%) with steps were located indoors.

Research Question: Is the presence of steps within a segment related to its use for walking for recreation/ getting to destinations?

Path use for getting to destinations

Results: The presence of steps within a segment was not related to its use for walking to destinations (p=0.2). This was true when path use by different categories of residents was considered (p>0.2), with the exception of cottage residents (p=0.036). Cottage residents used 15% of path segments without steps for walking to destinations and only 5% of path segments with steps in them.

Path use for recreational walking

Results: The presence of steps within a path segment was related to its use for walking for recreation. A higher percentage of path segments without steps were used as compared to path segments with steps for recreational walking at LV (Table 6.21). This was also true when path use by different categories of residents was considered. There was no difference in path use between path segments with and without steps by residents using assistive devices and insufficiently active residents.

Table 6.13: More path segments without steps were used for recreational walking as compared to path segments with steps.

Segment use for walking for recreation by…	Use category	Path segments without steps	Path segments with steps	Chi-square	p-value
Overall	No use Some use	17% 83%	37% 63%	11.6	.001
Male	No use Some use	26% 74%	57% 43%	19.7	.000
Female	No use Some use	34% 66%	55% 45%	8.5	.003
Residents not using any assistive device	No use Some use	17% 83%	39% 61%	12.7	.000
Residents with health problems	No use Some use	56% 44%	71% 29%	4.3	.039
Residents without health problems	No use Some use	19% 81%	47% 53%	20.0	.000
Residents aged below 72 years	No use Some use	34% 66%	57% 43%	9.9	.002
Residents between 73 to 80 years	No use Some use	45% 55%	76% 24%	18.1	.000
Residents aged 81	No use	44%	61%	5.6	.017

Table 6.13: More path segments without steps were used for recreational walking as compared to path segments with steps.

and over	Some use	56%	39%		
Sufficiently active residents	No use Some use	55% 45%	74% 26%	7.0	.008
Highly active residents	No use Some use	21% 79%	46% 54%	16.0	.000
Cottage residents	No use Some use	66% 34%	98% 2%	26.0	.000
Apartment residents	No use Some use	18% 82%	37% 63%	9.7	.002

6.2.1.12 Path Continuity

A majority of the path segments on campus (94%) formed direct and useful routes. Relatively few path segments were disjointed (Table 6.22). Most of the disjointed path segments were outdoor path segments that were either incomplete (the connection to other path segments had not been built) or were not easily incorporated within a continuous walking route. Since there were very few path segments on campus (6%) that were disjointed, this variable was excluded from the analysis.

6.2.1.13 Number of amenities present

Forty nine percent of the path segments on the LV campus had no amenities (benches, water fountains, handrails) along them. As can be seen from the plan (Figure 6.7), 83% of the indoor path segments had one or more amenities along them. The only outdoor path segments that had amenities (benches, trash cans) along them are the ones in the landscaped garden to the north of the west village.

Research question: Is the presence of one or more amenities on a path segment related to its use for walking for recreation/getting to destinations?

Figure 6.7: Most of the path segments on campus with amenities (red) are located indoors

Path use for getting to destinations

Results: Presence of amenities along the path segment was related to its use for walking to destinations. More path segments on LV with one or more amenities were used as compared to path segments without amenities (Table 6.14). This relationship was significant when all respondents were considered and when path use by the following categories of respondents was considered: male residents, female residents, residents not using assistive devices, residents with health problems and residents between the age of 73 and 80.

Table 6.14: More path segments with amenities were used for getting to destinations

Segment use for walking to destinations by…	Use category	Path segments with no amenities	Path segments with one or more amenities	Chi-square	p-value
Overall	No use Some use	79% 21%	67% 33%	4.7	.029
Male	No use Some use	84% 16%	72% 28%	5.6	.018
Female	No use Some use	98% 2%	91% 9%	5.4	.02
Residents not using any assistive device	No use Some use	80% 20%	69% 31%	4.3	.038
Residents with health problems	No use Some use	94% 6%	83% 17%	7.7	.006
Residents between 73 to 80 years	No use Some use	92% 8%	82% 18%	5.8	.016

Path use for walking for recreation

Results: There was a significant relationship between the presence of amenities and use of path segments for walking for recreation. However, the result is contrary to expectation. A higher percentage of path segments *without* amenities were used for recreation as compared to path segments with amenities (Table 6.15). This pattern holds true even for path use by different categories of residents. It is possible that this relationship turned out to be significant because most of the path segments without amenities are outdoor path segments (74%), many of which were used for recreational walking.

Table 6.15: More path segments without amenities were used for walking for recreation

Segment use for walking for recreation by…	Use category	Path segments with no amenities	Path segments with one or more amenities	Chi-square	p-value
Overall	No use Some use	13% 87%	29% 71%	10.9	.001
Male	No use Some use	21% 79%	44% 56%	15.8	.000
Residents using assistive device	No use Some use	93% 7%	99% 1%	4.7	.027
Residents not using any assistive device	No use Some use	14% 86%	30% 70%	10.6	.001
Residents with health problems	No use Some use	53% 47%	66% 34%	5.3	.021

Table 6.15: More path segments without amenities were used for walking for recreation

Residents without health problems	No use Some use	16% 84%	34% 66%	11.4	.001
Residents between 73 to 80 years	No use Some use	37% 63%	66% 34%	22.4	.000
Residents aged 81 and over	No use Some use	38% 62%	58% 42%	10.0	.001
Insufficiently active residents	No use Some use	91% 9%	99% 1%	7.9	.005
Highly active residents	No use Some use	17% 83%	36% 64%	11.7	.001
Cottage residents	No use Some use	51% 49%	93% 7%	60.7	.000
Apartment residents	No use Some use	15% 85%	29% 71%	7.8	.005

6.2.1.14 Presence of destinations on Path Segments

Residential areas were located along 35% of the path segments on the LV campus (Figure 6.8), activity related areas on 16% (Figure 6.9), parking areas on 7% (Figure 6.10) and admin areas along 6% of path segments. Natural destinations (pond, gazebo) were found on 3% of path segments on LV. Nature destinations and other destinations such as shops, chapel, beauty salon and admin areas were found along fewer than 5% of the path segments and were excluded from the analysis.

Figure 6.8: Path segments in red have residential destinations along them

Figure 6.9: Path segments in red have activity related destinations along them

Figure 6.10: Path segments with parking destinations along them (red)

Research Question: Is the presence of a specific destination on a path segment related to its use for walking to destinations/ walking for recreation?

Path use for walking to destinations

Residential areas

Path segments with residential areas were used no differently from other types of path segments while walking to destinations (p=0.4) when all residents were considered. When path use by different resident categories was considered, some significant relationships were observed (Table 6.16). Path segments with residential destinations were used no differently from path segments without residential destinations for the other resident categories (p>0.4).

Table 6.16: More path segments with residential destinations were used for walking to destinations

Segment use for walking to destinations by…	Use category	Path segments with no residential destination (%)	Path segments with residential destinations (%)	Chi-square	p-value
Residents with health problems	No use Some use	92 8	79 21	10.9	.001
Residents between 73 to 80 years	No use Some use	89 11	80 20	4.3	.039
Residents aged 81 and over	No use Some use	88 12	78 22	4.9	.027
Insufficiently active residents	No use Some use	91 9	80 20	6.4	.012
Apartment residents	No use Some use	44 56	25 75	9.7	.002

Activity-related areas

A higher percentage of path segments with activity related areas were used for walking to destinations as compared to path segments with no activity related areas (Table 6.17). This was true even when path use by categories of residents was considered. The only exceptions were path use by female residents, sufficiently active residents and apartment residents. When path use by all residents was considered, we found that as many as 45% of path segments with activity related areas were used for walking to destinations while only 24% of path segments without activity related areas were used for walking to destinations at LV.

Table 6.17: More path segments with activity related destinations along them were used for walking to destinations on LV.

Segment use for walking to destinations by…	Use category	Path segments with no activity related destinations	Path segments with activity related destinations	Chi-square	p-value
Overall	No use Some use	76% 24%	55% 45%	8.3	.004
Male	No use Some use	81% 19%	61% 39%	8.2	.004
Residents using assistive device	No use Some use	96% 4%	86% 14%	5.8	.016
Residents not using any assistive device	No use Some use	77% 23%	55% 45%	9.6	.002
Residents with health problems	No use Some use	90% 10%	75% 25%	7.7	.005
Residents without health problems	No use Some use	80% 20%	57% 43%	10.5	.001
Residents below 72	No use Some use	85% 15%	68% 32%	7.5	.006
Residents between 73 to 80 years	No use Some use	88% 12%	75% 25%	5.0	.025
Residents aged 81 and over	No use Some use	87% 13%	68% 32%	10.3	.001
Insufficiently active residents	No use Some use	98% 2%	87% 13%	10.8	.001
Highly active residents	No use Some use	78% 22%	57% 43%	9.1	.003
Cottage residents	No use Some use	89% 11%	77% 23%	4.7	.03

Administrative areas

More path segments with administrative areas (offices, reception desk, etc.) along them were used for walking to destinations on LV as compared to path segments without administration related destinations (Table 6.18). This was true when path use by most categories of residents was considered. There was no difference in use of path segments with and without administration related destinations when the following categories of residents were considered: residents using assistive devices (p=0.2), residents with health problems (p=0.08), residents aged 73 to 80 (p=0.5), sufficiently active residents (p=0.97) and apartment residents (p=0.7).

Table 6.18: More path segments with administration related destinations along them are used for walking to destination on LV

Segment use for walking for walking to destinations by…	Use category	Path segments with no admin-related destinations	Path segments with admin-related destinations	Chi-square	p-value
Overall	No use Some use	74% 26%	40% 60%	8.3	.004
Male	No use Some use	79% 21%	53% 47%	5.5	.019
Female	No use Some use	81% 19%	53% 47%	6.5	.011
Residents not using any assistive device	No use Some use	75% 25%	40% 60%	9.1	.003
Residents without health problems	No use Some use	78% 22%	40% 60%	11.2	.001
Residents below 72	No use Some use	84% 26%	53% 47%	9.4	.002
Residents aged 81 and over	No use Some use	86% 14%	60% 40%	7.1	.008
Insufficiently active residents	No use Some use	97% 3%	87% 13%	5.0	.024
Highly active residents	No use Some use	77% 23%	47% 53%	6.7	.009
Cottage residents	No use Some use	89% 11%	53% 47%	16.4	.000

Parking

Path segments with parking areas along them were used no differently from path segments without parking areas for walking to destinations at LV (p=0.2). This was true even when only outdoor path segments were included in the analysis and when path use by different categories of residents was considered (p>0.2).

<u>Path use for walking for recreation</u>

Residential areas

Path segments with residential destinations along them were used no differently for recreational walking on LV as compared to path segments with no residential destinations along them (p=0.3). When path use by resident categories is considered we find that more path segments with *no residential destinations* along them were used for recreational walking as compared to path segments with residential destinations. The opposite is true for residents aged 72 years or below. The relationship is non-significant for male residents (p=0.97), female residents (p=0.086), residents using assistive devices (p=0.07), residents not using assistive devices (p=0.4), residents with no health problems (p=0.2), insufficiently active residents (p=0.08), sufficiently active residents (p=0.8), highly active residents (p=0.3) and apartment residents (p=0.2).

Table 6.19: Relationship between path use for recreation and presence of residential destination along segment

Segment use for walking for recreation by…	Use category	Path segments with no residential destinations	Path segments with residential destinations	Chi-square	p-value
Residents with health problems	No use Some use	53 47	72 28	9.5	.002
Residents below 72	No use Some use	44 56	30 70	5.4	.02
Residents aged between 73 and 80	No use Some use	44 56	67 33	12.9	.000
Residents aged 81 and over	No use Some use	39 61	65 35	16.3	.000
Cottage residents	No use Some use	62 38	95 5	33.8	.000

Activity-related areas

Path segments with activity-related areas were used no differently for recreational walking on LV from path segments with no activity related areas along them (p=0.5). This was true when path use by all residents was considered and when path use by categories of residents was considered (p>0.3 for all categories).

Parking

Path segments with parking areas were used no differently for recreational walking on LV from path segments with no activity related areas along them (p=0.06). When path use by categories of residents was considered we found some significant relationships (Table 6.20).

Table 6.20: More path segments with parking destinations were used for recreational walking at LV

Segment use for walking for recreation by…	Use category	Path segments with no parking destinations	Path segments with parking destinations	Chi-square	p-value
Male	No use Some use	35 65	10 90	5.2	.023
Residents with health problems	No use Some use	62 38	30 70	7.9	.005
Residents aged 73 to 80	No use Some use	55 45	15 85	11.8	.001
Highly active residents	No use Some use	29 71	5 95	5.3	.022
Cottage residents	No use Some use	78 22	10 90	43.6	.000

6.2.1.15 Number of destinations on path segments

Forty-five percent of the path segments on the LV campus had no destinations along them. Around 44% have one destination. Thus, the key distinction appeared to be between path segments that had some destinations versus path segments that had no destinations (Figure 6.11). For purpose of analysis, two categories were created – path segments with no destinations and those with one or more destinations.

Figure 6.11: Path segments with one or more destinations along them (red) and no destinations (blue) at LV

Research question: Are more path segments with destinations along them used for walking for recreation/getting to destinations as compared to path segments with no destinations?

Path use for walking to destinations

There was no difference between path segments with and without destinations in terms of their use for getting to destinations on the LV campus ($p=0.2$). This is true when path use by most categories of residents was also considered ($p>=0.2$). The only exceptions were for path use by male residents, residents using assistive devices, residents with health problems and residents aged 81 and over and insufficiently active residents. These residents all chose a higher percentage of path segments with destinations as compared to path segments with no destinations ($p<0.05$).

Path use for walking for recreation

There was no difference between path segments with and without destinations in terms of their use for walking for recreation on the LV campus ($p=0.4$). This was true when path use by different categories of residents was also considered ($p>=0.1$). The only exception was path use by cottage residents ($p=0.003$). They used a higher percentage (36%) of path segments with no destinations as compared to path segments with destinations (19%).

6.2.2 Relational Path Characteristics

6.2.2.1 Number of views

Three or more different types of views could be seen from 61% of the path segments on the LV campus. Seventy-one percent of the outdoor path segments had many different types of views. Indoor path segments through common areas such as the clubhouse also had many views (Figure 6.12). Some outdoor path segments along the perimeter of the campus and indoor path segments between resident apartments had few views.

Figure 6.12: Path segments with many views (red) and path segments with few views (blue)

Research Question:

Are more path segments, from which many different views can be seen, used for walking for recreation/to get to a destination as compared to path segments with few or no views?

Results

Walking to get to destinations:

Path segments with more views were used no differently from path segments with few or no views while walking to destinations on campus (p=0.22). This was also true when path use by categories of residents was considered (p>=0.2), with the exception of path use by cottage residents (p=0.005). Cottage residents used 17% of the path segments with many views and only 6% of path segments with none or few views. This might be explained by the fact that cottage residents used outdoor path segments (which have many views) to walk to destinations at LV.

Walking for recreation

A higher percentage of path segments with many views (83%) were used for recreational walking as compared to path segments with no or few views (71%) (Table 6.21). When path use by categories of residents was considered, the number of views from the path segment was related to path use for recreation by most categories of residents except: female residents, residents using assistive devices, residents aged below 72 years, insufficiently active residents and sufficiently active residents.

Table 6.21: More path segments from which many different types of views could be obtained were used for recreational walking

Segment use for walking for recreation by…	Use category	Path segments with few views	Path segments with many views	Chi-square	p-value
Overall	No use Some use	29% 71%	17% 83%	5.8	.015
Male	No use Some use	45% 55%	26% 74%	10.9	.001
Residents not using any assistive device	No use Some use	30% 70%	17% 83%	6.0	.014
Residents with health problems	No use Some use	72% 28%	52% 48%	11.0	.001
Residents without health problems	No use Some use	35% 65%	19% 81%	8.4	.004
Residents aged 73 to 80	No use Some use	77% 23%	36% 64%	42.5	.000
Residents aged 81	No use	64%	38%	16.9	.000

Table 6.21: More path segments from which many different types of views could be obtained were used for recreational walking

and over	Some use	36%	62%		
Highly active residents	No use Some use	36% 64%	21% 79%	8.1	.004
Cottage residents	No use Some use	97% 3%	58% 42%	51.7	.000
Apartment residents	No use Some use	29% 71%	19% 81%	4.1	.042

6.2.2.2 Presence of specific types of views

Residential views were the most common (70%) from along path segments on the LV campus (Figure 6.13). Many of the path segments on LV had views to landscaped areas on campus (52%) (Figure 6.14) and to destinations not on the path but visible from the path (52%). Other types of views that were common included views of untended nature (e.g. forested areas) (32%), views of art (32%) and views of parking (23%). As many as 17% of the path segments did not have any of the above views.

Figure 6.13: Path segments in red have views to residential areas

Figure 6.14: Path segments in red have views to landscaped nature

Research Question:

Are more path segments from which specific types of views can be seen used for walking for recreation/to get to a destination as compared to path segments from which this view cannot be obtained?

Path use for getting to destinations

The presence of views of residential areas, tended nature, untended nature, destinations not on path, parking and water were not related to path use for walking to destinations. However, path segments with views to public spaces and views to art were used more often than path segments that did not have these views.

Views of public spaces (lobby, plaza)

A higher percentage of path segments with views to public spaces (lobby, plaza etc.) were used for walking to get to destinations as compared to path segments with no views to such spaces (Table 6.22). This relationship was also true for path use for getting to destinations by most categories of residents.

Table 6.22: Path segments with views to public spaces were used more for walking to destinations

Segment use for walking to destinations by…	Use category	Path segments with no view of public places	Path segments with views of public places	Chi-square	p-value
Overall	No use Some use	76% 24%	56% 44%	8.3	.004
Male	No use Some use	81% 19%	59% 41%	10.6	.001
Female	No use Some use	82% 18%	66% 34%	5.6	.017
Residents using assistive devices	No use Some use	97% 3%	80% 20%	20.4	.000
Residents not using any assistive device	No use Some use	77% 23%	55% 45%	9.6	.002
Residents with health problems	No use Some use	91% 8%	68% 32%	18.2	.000
Residents without health problems	No use Some use	80% 205	55% 45%	13.2	.000
Residents aged 73 to 80	No use Some use	89% 11%	68% 32%	13.4	.000
Residents aged 81 and over	No use Some use	89% 115	61% 39%	21.0	.000
Insufficiently active residents	No use Some use	99% 1%	84% 16%	26.0	.000
Sufficiently active residents	No use Some use	90% 10%	73% 27%	9.2	.002
Highly active residents	No use Some use	78% 22%	61% 39%	5.1	.024
Cottage residents	No use Some use	89% 11%	77% 23%	4.7	.03

Views to art

A higher percentage of path segments with views of artwork (37%) were used for walking to destinations as compared to path segments with no views of artwork (23%) (Table 6.34). Further, this held true for path use by most resident categories.

When all path segments were considered there was a significant relationship between views to artwork from along the path segments and their use for walking to destinations. However, on the LV campus, artwork was located inside the buildings. The analysis was also conducted with the indoor path segments alone to see if views to artwork among this set of segments was related to its use for walking to destinations. This analysis showed that there was no relationship between views to artwork from indoor path segments and their use for walking to destinations suggesting that this finding primarily shows the difference in use of indoor and outdoor path segments for instrumental walking.

Table 6.23: More path segments with views to artwork were used for getting to destinations

Segment use for walking to destinations by…	Use category	Path segments with no view of artwork	Path segments with views of artwork	Chi-square	p-value
Overall	No use Some use	77% 23%	63% 37%	5.4	.020
Male	No use Some use	84% 16%	66% 34%	11.6	.001
Female	No use Some use	83% 17%	72% 28%	4.0	.044
Residents using assistive devices	No use Some use	99% 1%	84% 16%	23.1	.000
Residents not using any assistive device	No use Some use	78% 22%	64% 36%	5.5	.018
Residents with health problems	No use Some use	96% 4%	71% 29%	33.7	.000
Residents without health problems	No use Some use	80% 20%	68% 32%	4.9	.026
Residents aged 73 to 80	No use Some use	92% 8%	73% 27%	17.1	.000
Residents aged 81 and over	No use Some use	91% 95	71% 29%	17.8	.000
Insufficiently active residents	No use Some use	100% 0%	90% 10%	6.5	.010
Apartment residents	No use Some use	44% 56%	23% 77%	6.9	.008

Path use for recreational walking

Views to untended nature (forests), public places, parking, art or water from path segments was not related to path use for recreational walking. However, more path segments with views to residential areas, tended nature and other destinations (not on path) were used for walking for recreation as compared to path segments without these views.

Views to residential areas

More path segments with views to residential areas were used for recreational walking as compared to path segments without views to residential areas (Table 6.24). The relationship between presence of views to residential areas and path use for recreation was not significant for the following resident categories: residents using assistive devices, residents over 81 years, insufficiently active and sufficiently active residents.

Table 6.24: More path segments with views to residential areas were used for recreational walking

Segment use for walking for recreation by…	Use category	Path segments with no view of residential areas	Path segments with views of residential areas	Chi-square	p-value
Overall	No use Some use	42% 58%	13% 87%	27.7	.000
Male	No use Some use	59% 41%	22% 78%	34.1	.000
Female	No use Some use	50% 50%	34% 66%	6.0	.014
Residents not using any assistive device	No use Some use	43% 57%	14% 86%	28.4	.000
Residents with health problems	No use Some use	72% 28%	54% 46%	7.3	.007
Residents without health problems	No use Some use	49% 51%	15% 85%	34.8	.000
Residents aged 72 or less	No use Some use	56% 44%	32% 68%	13.8	.000
Residents aged 73 to 80	No use Some use	73% 27%	43% 57%	20.9	.000
Highly active residents	No use Some use	49% 51%	18% 82%	28.4	.000
Cottage residents	No use Some use	90% 10%	66% 34%	17.4	.000
Apartment residents	No use Some use	42% 58%	15% 85%	23.9	.000

Views to tended nature

More path segments with views to tended (landscaped) nature were used for walking for recreation as compared to path segments without those views (Table 6.36). This was true even when path use by different resident categories was considered.

Table 6.25: More path segments with views to tended nature were used for recreational walking

Segment use for walking for recreation by…	Use category	Path segments with no views to tended nature	Path segments with views to tended nature	Chi-square	p-value
Overall	No use Some use	28% 72%	15% 85%	6.7	.010
Male	No use Some use	45% 55%	22% 78%	16.8	.000
Residents using assistive devices	No use Some use	99% 1%	94% 6%	4.4	.034
Residents not using any assistive device	No use Some use	29% 71%	16% 84%	6.5	.010
Residents with health problems	No use Some use	73% 27%	47% 53%	19.3	.000
Residents without health problems	No use Some use	32% 68%	18% 82%	7.5	.010
Residents between 73 to 80 years	No use Some use	76% 24%	29% 71%	60.9	.000
Residents aged 81 and over	No use Some use	61% 39%	35% 65%	18.3	.000
Highly active residents	No use Some use	35% 65%	19% 81%	9.6	.002
Cottage residents	No use Some use	99% 1%	48% 52%	88.5	.000
Apartment residents	No use Some use	28% 72%	17% 83%	4.4	.034

Views to other destinations (not on path)

More path segments with views to destinations (not located on the path) were used for recreational walking as compared to path segments without those views. As many as 86% of path segments with views to destinations were used while only 71% of path segments without these views were used for recreational walking (Table 6.26). This relationship was true when path use by categories of residents was considered. The only exceptions were for path use by residents using assistive devices, residents aged 72 or less and insufficiently active residents.

Table 6.26: More path segments with views to destinations not on path were used for recreational walking

Segment use for walking for recreation by…	Use category	Path segments with no view to destinations	Path segments with views to destinations	Chi-square	p-value
Overall	No use Some use	29% 71%	14% 86%	8.3	.004
Male	No use Some use	41% 59%	25% 75%	7.9	.005
Female	No use Some use	48% 52%	30% 70%	8.9	.003
Residents not using any assistive device	No use Some use	29% 71%	15% 85%	8.1	.004
Residents with health problems	No use Some use	73% 27%	47% 53%	19.3	.000
Residents without health problems	No use Some use	33% 67%	17% 83%	9.1	.002
Residents between 73 to 80 years	No use Some use	70% 30%	35% 65%	34.3	.000
Residents aged 81 and over	No use Some use	61% 39%	35% 65%	18.3	.000
Sufficiently active residents	No use Some use	68% 32%	51% 49%	8.5	.002
Highly active residents	No use Some use	37% 63%	17% 83%	13.2	.000
Cottage residents	No use Some use	90% 10%	57% 43%	37.7	.000
Apartment residents	No use Some use	29% 71%	16% 84%	7.2	.007

6.2.3 Global path characteristics

6.2.3.1 Mean Depth

The depth between two segments is the minimum number of spaces that must be traversed to go from one to the other. This variable is a measure of centrality of a path segment with respect to the network of path segments. The site plan of LV (Figure 6.15) shows a gradient of mean depth values (from red to purple to blue) where red indicates path segments that were the most central while blue path segments were the least central.

Figure 6.15: Path segments on campus range from closer to all other path segments (red) to deeper from all other path segments (blue)

The most central path segments were located at the center of the campus.
The path segments on the fourth floor of the West and East Village buildings and all path segments in the clubhouse were central within the network of path segments on campus. The landscaped nature trails behind the Village buildings and the path running along the

perimeter of the campus were also more central with regard to all other path segments on campus. The clusters of cottages were the farthest from all other path segments on campus. The path segments on the resident floors in the East Village building were also less central (Figure 6.15).

For the purpose of analysis mean depth values were collapsed into two main categories around the mean – less central and more central.

Research question: Are path segments that are more central within the network of path segments on campus used for walking for recreation/getting to destinations as compared to path segments that are less central?

Results:

Path use for getting to destinations

Overall, more central path segments were used no differently from less central path segments for walking to destinations at LV (P=0.97). This relationship was true even for path use by most resident categories. The exceptions were for path use by residents using assistive devices (p=0.01), residents aged between 73 and 80 (p=0.026) and apartment residents (p=0.022). In these cases, residents chose more path segments that were more central within the network as compared to path segments that were less central.

Path use for recreational walking

Overall, more central path segments were used no differently from less central path segments for recreational walking at LV (P=0.93). This relationship was also true for path use by most resident categories. The exception were for path use by sufficiently active residents (p=0.000), insufficiently active residents (p=0.018), residents aged 72 years or below (p=0.023) and male residents (p=0.049). All four categories of residents used a higher percentage of more central path segments for recreational walking as compared to less central path segments.

6.2.3.2 Choice (betweenness centrality)

This is a measure of how many times a path segment will be found lying on routes connecting two points in the system. That is, the number of routes that the path segment is potentially a part of in the system of path segments on campus. Eight percent of all path segments did not lie between any two path segments – that is they formed a dead end. Path segments were distributed into two categories about the median – low choice and high choice (Figure 6.16). Path segments along the perimeter of the campus and in the landscaped garden were high choice segments. Path segments on the 4th floor of the East and West Village connected with the clubhouse were also high choice segments. Many of the vertical (stair and elevator) segments on campus were also high choice segments.

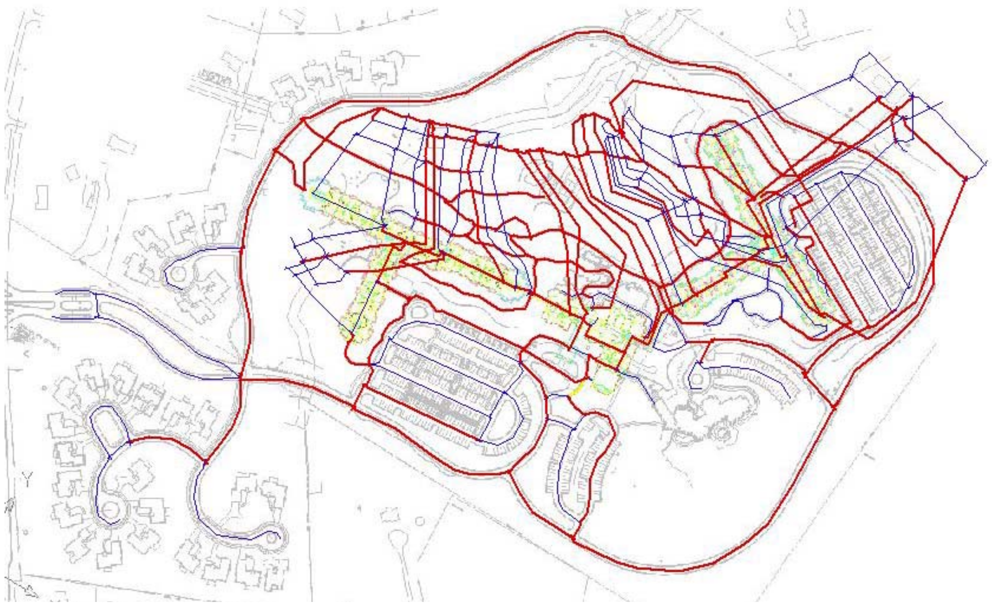


Figure 6.16: High choice (red) and low choice (blue) path segments on the PS campus.

Research question: Are path segments that lie on many routes on campus likely to be used more for instrumental/ recreational walking?

Path use for walking to destinations

A higher percentage of path segments that lay on many routes connecting path segments on campus were used for walking to destinations at LV (Table 6.28). This was true when path use by all categories of residents was considered as well, without exception.

Table 6.27: Path segments that were part of more routes on campus were used more for walking to destinations

Segment use for walking to destinations by…	Use category	Path segments with few choice	Path segments with many choices	Chi-square	Sigma
Overall	No use Some use	80% 20%	65% 35%	7.5	.006
Male	No use Some use	86% 145	70% 30%	9.5	.002
Female	No use Some use	86% 14%	72% 28%	8.2	.004
Residents using assistive device	No use Some use	99% 1%	90% 10%	9.6	.002
Residents not using any assistive devices	No use Some use	80% 20%	66% 34%	6.9	.009
Residents with health problems	No use Some use	94% 6%	82% 18%	8.7	.003
Residents without health problems	No use Some use	84% 16%	68% 32%	9.8	.002
Residents aged 72 or less	No use Some use	88% 12%	77% 23%	5.7	.024
Residents between 73 to 80 years	No use Some use	91% 9%	80% 20%	6.8	.009
Residents aged 81 and over	No use Some use	93% 7%	76% 24%	14.7	.000
Insufficiently active residents	No use Some use	99% 1%	94% 6%	5.6	.017
Sufficiently active residents	No use Some use	91% 9%	83% 17%	4.7	.03
Highly active residents	No use Some use	82% 8%	68% 32%	7.2	.007
Cottage residents	No use Some use	95% 5%	80% 20%	14.6	.000
Apartment residents	No use Some use	44% 56%	30% 70%	6.0	.014

Path use for walking for recreation

Results: There was a relationship between choice and path use for walking to recreation at LV, though this relationship is not significant when all categories of residents are considered. A higher percentage of high choice path segments were used for walking for recreation as compared to low choice path segments (Table 6.29). This was not true for path use by residents using assistive devices, insufficiently active residents, highly active residents and cottage residents.

Table 6.28: More path segments that were part of many routes on campus were used for recreation.

Segment use for walking for recreation by…	Use category	Path segments with few choices	Path segments with many choices	Chi-square	Sigma
Male	No use Some use	41% 59%	25% 75%	8.5	.004
Female	No use Some use	50% 50%	28% 72%	14.3	.000
Residents not using any assistive devices	No use Some use	28% 72%	17% 83%	4.6	.032
Residents with health problems	No use Some use	70% 30%	49% 51%	13.0	.000
Residents without health problems	No use Some use	33% 67%	17% 83%	10.0	.002
Residents aged 72 or less	No use Some use	49% 51%	30% 70%	9.9	.002
Residents between 73 to 80 years	No use Some use	65% 35%	39% 61%	19.3	.000
Residents aged 81 and over	No use Some use	59% 41%	37% 63%	12.6	.000
Sufficiently active residents	No use Some use	75% 25%	48% 52%	28.4	.000
Apartment residents	No use Some use	28% 72%	18% 82%	3.95	.047

6.3 Analysis of high use path segments for recreation

In order to understand if there was a difference between different groups of residents in terms of the path segments that were highly used for recreational walking, the twenty high use path segments (for recreation) by different resident categories were identified and compared.

Overall

When all residents were considered we found that there were some key indoor and indoor path segments that were used a lot for recreational walking (Figure 6.17). The corridor spine connecting east and west villages on the fourth floor and running through the clubhouse was used often for walking when responses by all residents were considered. Outdoor road segments leading to the cottages and running around the perimeter of the campus were used often as well. These segments do not have sidewalks or amenities such as benches along them. Further, these path segments all have either moderate or steep slopes.

Figure 6.17: The 20 path segments on campus that were used most for walking for recreation when all categories of residents were considered

Gender

Both male and female residents used indoor and outdoor path segments for recreational walking. Male residents used more of the longer outdoor path segments along the perimeter of the campus for recreational walking (figure 6.18). Female residents used more indoor path segments for walking for recreation (figure 6.19). Indoor path segments used most by male and female residents were the corridor spines on the 4th floor connecting the east village apartments and the west village apartments.

Figure 6.18: Twenty path segments used most for recreation by male residents at LV (in red)

Figure 6.19: Twenty path segments used most for recreation by female residents at LV (in red)

Use of assistive devices

Residents using assistive devices walked along the perimeter of the parking lot adjacent to the east village (figure 6.20). The parking lot was fairly level and did not see much traffic as the east village was not fully occupied at the time of the study. Residents who did not use assistive devices used both indoor and outdoor path segments for walking (Figure 6.21)

Figure 6.20: Twenty path segments used most for recreation by residents using assistive devices

Figure 6.21: Twenty path segments used most for recreation by residents not using any assistive devices

Reported health problems

The path segments that were used most often by residents reporting health problems were all located indoors – most of the path segments were located between resident apartments (Figure 6.22). Among residents who did not report health problems – highly used path segments were outdoor path segments along the perimeter (south side) of the campus and indoor path segments on the fourth floor (Figure 6.23).

Figure 6.22: Twenty path segments most used for recreation by residents reporting health problems (in red)

Figure 6.23: Twenty path segments used most for recreation by residents reporting no health problems

Age

There is no clear difference in the characteristics of the most used path segments between residents in the three age categories. Residents in all three age categories used indoor and outdoor path segments for recreation (Figure 6.24-6.26). Indoor path segments used were primarily the resident corridors on the 4th floor of the east and west village. Outdoor path segments that were most used were the road segments along the perimeter of campus – though different road segments were used most by the different age categories.

Figure 6.24: Twenty path segments used most for recreation by residents aged 72 years or less (in red)

Figure 6.25: Twenty path segments used most for recreation by residents aged between 73 and 80 years (in red)

Figure 6.26: Twenty path segments used most for recreation by residents aged 81 and over

Activity level

Insufficiently active residents used the road segments leading from the main entrance to the east village the most (figure 6.27). The path segments that were used most for recreation by sufficiently active residents were all indoor path segments between resident apartments or through the clubhouse (Figure 6.28). Both indoor (west village corridors) and outdoor path segments (road segments along the perimeter) were used most by highly active residents (Figure 6.29).

Figure 6.27: Twenty path segments used most for recreation by insufficiently active residents

Figure 6.28: Twenty path segments used most for recreation by sufficiently active residents

Figure 6.29: Twenty path segments used most for recreation by highly active residents

Type of residence

Apartment residents used both indoor and outdoor path segments for recreational walking – though most of the path segments that were highly used by apartment residents were located indoors (fourth floor corridor spine) (Figure 6.30). All path segments that were highly used by LV cottage residents were outdoor segments (located close to the cottages). None of the indoor path segments were used highly by cottage residents for recreation (Figure 6.31).

Figure 6.30: Twenty path segments most used for recreation by apartment residents (in red)

Figure 6.31: Twenty path segments most used for recreation by cottage residents (in red)

If we compare figure 6.2 (path segments that were used at all for recreation) with figure 6.17-6.31 (path segments that were used highly for recreation) we see that even though a large majority of path segments on the LV campus were used for recreational walking, it is consistently the same set of path segments that is chosen by all different types of residents for walking. Even though there are some variations between resident categories, it is clear that there are some indoor path segments – the corridors between residents apartments on the 4^{th} floor and the path segments through the clubhouse on the 4^{th} floor and some outdoor path segments – roads running along the perimeter of the campus – that are used most by residents.

6.4 Analysis of highly used recreation routes

Outdoor routes

There are 5 main outdoor routes (including minor variations of these routes) that were selected by residents during their recreational walk on the LV campus (Figure 6.32). Table 6.30 shows which routes were chosen by different categories of residents.

Figure 6.32: Highly used outdoor recreation routes at LV

Table 6.29: Number of residents in different categories who used different recreational routes for walking

Number of residents that used route…		**Only Route 1**	**Route 1 + others**	**Only Route 2**	**Only Route 3**	**Only Route 4**	**Only Route 5**	**Combined routes**	**Linear routes**	**Indoor route 1**	**Indoor route 2**
Age	72 years or less 73-80 years 81 years and over	2 0 1	3 3 1	0 0 1	0 2 1	0 2 2	0 0 0	5 4 3	0 3 1	1 0 0	4 7 6
Gender	Male Female	1 2	5 3	1 0	0 3	3 1	0 0	8 5	2 2	1 0	8 9
Type of residence	Apartment Cottage	3 0	6 2	1 0	3 0	4 0	0 0	9 4	3 1	1 0	17 0
Use assistive device for walking?	No Yes	3 0	8 0	1 0	3 0	3 1	0 0	13 0	2 0	1 0	16 1
Experienced health problems recently that affected walking	No Yes	3 0	8 0	0 1	1 2	1 3	0 0	12 1	3 1	1 0	12 5
Physical activity level (based on IPAQ)	Insufficiently active Sufficiently active Highly active	0 0 3	0 1 7	0 0 1	0 2 1	2 0 2	0 0 0	0 1 12	1 2 0	0 0 1	1 4 11

Route 1: Walking this route involved circling the perimeter of the campus (excluding the cottages). This was a fairly long walk; the distance walked was a little over a mile (Fig 6.32). There were no sidewalks or places to rest anywhere along this route, though the roads were wide and traffic was very light and slow moving (low speed limits mandated on campus). There were street lights at regular intervals. For the most part of this walk, there was no clear line of sight to any residential areas. The northwest and southeast parts of the site were forested and undeveloped for the most part. Further there were steep gradients along this route, especially along the south-west and northeast corners of the site. Overall, this was a challenging route. Three residents walked only this route and eight combined this route with others. A majority of the residents (10 residents) who chose this route said they walked for exercise. These residents were aware of the distance they walked and the benefits in terms of better health. A couple of residents mentioned they liked the uphill-downhill slopes along this route and four residents mentioned the pleasant scenery and wildlife. Four residents said that they walked this route for fun or to just get outside/get fresh air. None of the residents who took this route used an assistive device for walking or had experienced health problems that affected their walking behavior. Of the residents who chose this route, a majority were younger residents (aged 72 years or less). Also, of the 11 residents who chose this route, ten were classified as highly active.

Route 2: This route involved walking around three quarter of the campus perimeter. Typically residents walked the top half of the campus – through the landscaped path segments behind the West Village, along the north perimeter and returning back to the West Village through the clubhouse parking lot or through the roads leading to the health center (Figure 6.32). This route measured about 1 mile. The perimeter path segments have already been described (route 1). The road leading up to the health center was steep and without sidewalks. The landscaped path segments behind the West Village were attractively landscaped with beautiful views of the campus and surrounding forested areas. These path segments vary in gradient from relatively flat to moderately sloping. However, entry back into the buildings from this side of the campus requires a key card. Three residents walked this route or a minor variation of this and one resident walked only this route for recreation. All were classified as highly active and did not use any assistive devices.

Route 3: Residents walked the bottom half of the campus – along the south perimeter and cutting through the roads and the landscaped path segments behind the West Village (Figure 6.32). There were also minor variations to these routes where residents walked part of the perimeter and made their way to the West Village through the parking lot and Clubhouse entrance. Route 3 and its variations were between 0.6 and 0.7 miles long depending on the exact route taken.

Three respondents walked only this route and two combined this route with others. Two of the residents who used this route had experienced health problems that affected their walking and two were classified as sufficiently active. Of the five respondents who took this route, four were aged 73 years or above. Two residents who walked this route mentioned they liked the uphill and downhill slopes and the scenic route. Two residents mentioned exercise as the reason for selecting the route.

Route 4: This route involved walking around the parking lot in front of either the West Village or the East Village (Figure 6.32). The parking lots were relatively flat. Some parts of the parking lot were covered and provided protection from glare and rain. There were no benches here, though there were benches along the sidewalks leading to the Village buildings and clubhouse. Residents who walked the parking lots mentioned that they liked to walk early in the morning when the parking lot was quiet. The length of the walk varies depending on whether residents walked one circle around the perimeter of the lot (0.25 mile) or also walked in between the different lanes (0.4 mile). The reasons for selecting this route included exercise (3 residents) and safety (2 residents). One resident said he chose the route because it was close to the entry and exit of the building in which he resided. Four residents walked exclusively in the parking lot for recreation and eight residents combined route 4 with other routes. Of the four who walked exclusively in the parking lot three had experienced health problems, one out of the four used an assistive device for walking and two out of four were classified as insufficiently active.

Route 5: This route involved walking up and back along the roads leading to the cottages (Figure 6.32). These roads do not have sidewalks along them and they have steep gradients along them. Views to the cottages can be obtained from these path segments, though these routes are visually isolated from the rest of the campus. You cannot see any of the residential buildings or clubhouse from this part of the campus. Route 5 was not chosen exclusively for walking; it was always combined with route 1 (three residents) or route 3 (one resident) or route 4 (one resident) or route 1and route 4 (three residents).

Other routes: Two residents took short looped walks in the landscaped garden behind the West Village. Four residents walked along non-loop (linear) route (e.g. from the East Village main entrance to the gatehouse and back along the south perimeter). The lengths of these walks vary. The four residents who took these routes were all older (73 years or above) and were classified as insufficiently active or sufficiently active.

Indoor routes

Two types of indoor walks were taken – resident corridors in both apartment buildings or resident corridors in the building of residence.

Seventeen residents who walked indoors for exercise walked all or some of the resident corridors in the East and West Village building crossing from one building to the other on the 4th floor through the clubhouse (Table 6.41). A few of the residents mentioned that they took the stairs down from one floor to the next during their walk. If a residents walked back and forth along all resident corridors on one floor (both buildings) and the clubhouse, the total distance walked would be about 1 mile. Most residents either walked on one or more floors in both buildings or many floors in one building. One resident walked all floors of both buildings for recreation. This resident was classified as highly active, was 72 years or younger, did not use any assistive device and did not have any health problems.

Of the other residents who walked some of the floors, majority were 73 years or older, were classified as highly active, did not have any health problems and did not use any assistive devices for walking.

Most residents who walked the indoor routes said that they walked for exercise and were aware of the distance walked. Residents gave different reasons for choosing this indoor route including convenience, better walking level and protection from rain/humidity.

6.5 Summary of LV Case Study

The analysis above suggests that local, relational as well as global environmental factors are related to path segments being chosen for recreational and instrumental walking. The results of the analysis are summarized in the table below.

Path use for walking to destinations

The results show that more indoor path segments were used for walking to destinations on the LV campus. Clearly, the fact that the destinations were clustered in the clubhouse and that apartments residents had a convenient indoor route to the clubhouse may account for the fact that indoor path segments were preferred over outdoor path segments. Further, indoor path segments between resident apartments were used more often than other types (through public spaces, stairs etc.) of indoor path segments.

Fewer path segments/trails through landscaped areas were used for walking to destinations as compared to other types of outdoor path segments. Path segments which had one or more amenities along them were used for getting to destinations. The presence of destinations, especially activity related areas and administrative areas along path segments, was related to their use for walking to destinations. At LV, path segments through the clubhouse were used extensively for walking to destinations. The dining room, located on the main clubhouse level is an attractor for residents from the east and west village buildings as well as residents living in the cottages. However, there was no relationship between the number of destinations along a path segment and its use for walking to destinations (except for some resident categories).

Path segments from which more types of views can be obtained were used no differently from path segments with none or few views. However, more path segments with views of art or public spaces were used for walking to destinations. The path segments with views of art tend to be the path segments between resident apartments or path segments in the clubhouse.

Path segments that were more central within the network of paths on campus were used no differently from path segments that were less central within the network. The other global structural path characteristic – choice – or the number of routes that a path segment lies on – was related to path use for getting to destinations. Thus, more path segments that lay on many routes connecting path segments on campus were used for walking to destinations as compared to path segments that lay on fewer routes. There is also a strong relationship between depth and choice measures – 77% of high choice segments were also the more central path segments on campus ($p=0.000$). Given this strong relationship between these two structural variables, it is not clear why depth is also not related to path use for getting to destinations.

Local path characteristics such as path length, path material, path condition, path gradient, presence of street crossing and steps in the segment and presence of path obstructions were not related to path use for walking to destinations. Continuous path segments were used no differently from disjointed path segments for getting to destinations on LV. The location of indoor path segments was also not related to walking to destinations.

Path use for walking for recreation

When the relationship between path segment characteristics and path segment use at LV was considered, we found that local, relational and global environmental characteristics were related to path segments being used for recreation. The analysis shows that more outdoor path segments were used for recreation as compared to indoor path segments. However, it is interesting to note that many of the indoor path segments, especially path segments between resident apartments (Figure 6.2) were used for recreational walking. The statistical analysis also shows that more path segments between resident apartments were used for recreational walking as compared to all other types of indoor path segments.

There was a significant relationship between the length of path segments and their use for walking for recreation. A higher percentage of long path segments were chosen for recreational walking as compared to short path segments and this was true for all categories of residents. When we look at the site plans showing the highly used path segments on the LV campus (Figure 6.17 to 6.31), we see that the highly used path segments were the long indoor corridors between resident apartments and the long road segments along the perimeter of the campus.

Fewer outdoor path segments which were path/trails through landscaped gardens were used as compared to all other types of outdoor path segments. This is evident when we examine figure Figure 6.17 through Figure 6.31. The attractive landscaped trails located behind the village buildings were not highly used by any of the resident categories. This is contrary to expectation. One possible explanation for the low use of these path segments for recreation may be that there was restricted access to buildings (the clubhouse and village buildings) from this side of campus. Residents needed to have a key card if they wished to enter the buildings from this side. Thus, if residents forgot to carry their key card when they went for a walk, they could potentially get locked out or they would need to walk all the way around to the main entrance (a fairly long walk) to enter the building. The main entrances to the Village buildings and clubhouse on the other hand (south of the buildings) do not require key cards and are automatically operated.

More path segments made of bitumen (the road segments) were used for recreational walking as compared to other types of outdoor path segments. This was also evident from the analysis of the highly used path segments on campus – most were road segments around the perimeter of the campus.

More path segments without steps were used for walking for recreation as compared to path segments with steps. Other path characteristics such as path gradient, presence of path obstructions and presence of street crossings were not related to path use for recreation. Path continuity and path material of indoor path segments was excluded from the analysis since there was insufficient variation.

More path segments without amenities were used for recreational walking. This may be related to the fact that path segments with amenities are primarily indoor path segments and a lot of the recreational walking at LV occurs on the outdoor path segments.
The presence of destinations was not related to path segments being used for recreation. Also, the presence of any specific type of destination along the path segment was not related to path use for recreation. The number of views that can be seen from a path does not appear to matter though the presence of specific views – views of residential areas, views of tended nature and views of other destinations (visible from path but not on path) was related to path use for recreational walking.

There was no relationship between depth of the path segment and its use for recreational walking at LV. That is, path segments that were more central within the network were used no differently for recreational walking from less central path segments.

A higher percentage of path segments that lay on many different routes on campus were used for recreational walking as compared to path segments that lay on few routes on campus.

Table 6.30: Path characteristics that are related to path use for walking for recreation or for getting to destinations on the LV campus.

Path characteristics	Path use for getting to destinations	Path use for walking for recreation
Local Path characteristics		
Path Type: Does path type matter?	Yes: More indoor path segments tend to be used as compared to outdoor path segments. Not true for all resident categories.	Yes: More outdoor path segments tend to be used as compared to indoor path segments.
Path length: Are longer path segments used for walking more than short path segments?	No difference between long and short path segments.	Yes. Longer path segments tend to be used as compared to short path segments. This is true for overall path use and path use by resident categories.
Location of indoor path segments: Is the location of indoor path segments related to their use for walking?	No difference.	Yes. More path segments between resident apartments are used as compared to other types of indoor path segments.
Location of outdoor path segments: Is the location of outdoor path segments related to their use for walking?	Fewer path segments/trails through nature were used as compared to all other outdoor path segments.	Yes. Fewer path segments/trails through nature were used as compared to all other path segments.
Path material of outdoor path segments: Does path material matter?	No difference in path use between path segments constructed of different material	More outdoor path segments made of bitumen were used as compared to all other outdoor path segments.
Path material of indoor path segments: Does path material matter?	Variable excluded – insufficient variation	

Table 6.31: Path characteristics that are related to path use for walking for recreation or for getting to destinations on the LV campus

Path slope: Does path gradient (slope) matter?	No difference between flat, moderate and steep slope path segments.	More moderately sloping and steep path segments were used as compared to flat path segments
Path condition: Are more path segments in good condition used for walking?	Variable excluded – insufficient variation	
Presence of street crossing: Are path segments with street crossings used less?	No difference	No difference
Presence of path obstruction: Are fewer path segments with obstructions used for walking?	No difference	No difference
Presence of steps: Are more path segments without steps used for walking?	No difference.	Yes. More path segments without steps were used for recreation as compared to path segments with steps.
Path continuity: Are more direct path segments used for walking as compared to disjointed routes?	Variable excluded – insufficient variation	
Amenities: Are more path segments with amenities (benches, trashcans, handrails, etc) used for walking?	Yes.	The opposite relationship is true: more path segments *without* amenities were used for recreation.
Destinations: 1. Are more path segments with one or more destinations used for walking as compared to path segments without any destination? **2.** Is the presence of specific destinations related path use?	1. No 2. More path segments with *activity related areas* and *administrative areas* along them were used for walking to destinations	1. No 2. More path segments with parking destination were used for recreational walking (only some resident categories)

Table 6.32: Path characteristics that are related to path use for walking for recreation or for getting to destinations on the LV campus

Relational Path characteristics		
Views: 1. Are more path segments from which many different types of views are seen used for walking as compared to path segments with none or few views? 2. If a particular type of view (e.g. view of water) can be seen from a path does it tend to be used more often?	1. No difference between path segments with different number of views 2. More path segments with views of public spaces or art were used.	1. Yes 2. More path segments with views of residential areas, tended nature and destinations (not on path) were used.
Global Path Characteristics		
Average Distance: Are more central path segments used for walking as compared to less central path segments?	No difference (only some resident categories)	No difference (only some resident categories)
Betweenness-centrality (choice): Are more path segments that lie on many routes used for walking as compared to path segments that lie on few routes?	Yes	Yes

The analysis of highly used path segments on campus and the highly used routes taken together with the path segment use analysis provide some interesting findings. The key findings are summarized here:

- Path segments chosen for walking to destinations were for the most part determined by the location of the destination and location of an individual's residence. The tendency was to take the shortest and most convenient route.

- Indoor path segments (specifically between resident apartments) were used a lot for recreational walking.
- Residents preferred looped routes while walking outdoors as compared to linear routes (back and forth along same path).
- The route that was most popular – around the perimeter of campus – was also the most challenging in terms of local path characteristics (steep gradients, lack of sidewalks). Perhaps, the choice of this path by many respondents can be explained in terms of the long uninterrupted segments and the fact that most of the segments along this route were high choice (they fall on many routes on campus). Also, the attractive natural scenery along this path may have contributed to high use.
- The looped outdoor routes can be classified in terms of increasing length and increasing difficulty. Interestingly however, their use for walking was not proportionate to the level of difficulty.
- Route 1 was used exclusively by highly active, younger and healthy residents.
- Route 4 tended to also be used by insufficiently active residents and those experiencing health problems
- Very few residents walked exclusively along the landscaped path segments behind the Village buildings for recreation. These path segments tended to be included as part of a longer walk on campus. And, in those cases, residents walked along the longest and least fragmented route.

CHAPTER 7

CASE STUDY 3: PV RETIREMENT COMMUNITY

7.1 Survey Respondent Characteristics and Path use characteristics

7.1.1 Survey Respondent Characteristics

Thirty-six residents responded to the survey (28% response rate). The characteristics of the survey respondents are provided in the Table 7.1:

Table 7.1: Characteristics of PV survey respondents

Respondent characteristics		**Overall**		**Male**		**Female**	
		N	%	N	%	N	%
Age	72 years or less	2	6	1	8	1	4
	73-80 years	7	19	4	33	3	13
	81 years and over	27	75	7	58	20	83
Gender	Male	12	33	12	100		
	Female	24	67			24	100
Type of residence	Apartment	12	33	0	0	12	50
	Cottage	24	67	12	100	12	50
Length of stay at community	Less than 6 months	3	8	2	17	1	4
	6 months to one year	0	0	0	0	0	0
	One to three years	6	17	1	8	5	21
	Three to five years	4	11	1	8	3	23
	More than five years	23	64	8	67	15	62
Use assistive device for walking?	No	27	75	10	83	17	71
	Yes	9	25	2	17	7	29
Physical activity level (based on IPAQ)	Insufficiently active	12	33	5	42	7	29
	Sufficiently active	10	28	3	25	7	29
	Highly active	12	33	4	33	8	33
	Cases excluded	2	6	0	0	2	9

A majority of the respondents were 81 years of age or older (75%) with a range between 70 and 91. The median age of the respondents in the sample was 84 and the average age was 83. Women made up 67% of the respondents. Only a third of the respondents lived in the apartment building. This proportion was similar to the proportion of the larger resident population at PV that lived in apartments (38% of all PV residents lived in apartments). Sixty four percent of the respondents had lived for more than five years on the PV campus. A quarter of the sample used assistive devices for walking (Table 7.1). Information on reported health problems was not available for this community. In terms of physical activity levels, the sample was almost equally distributed between the three categories.

7.1.2 Path use for walking on campus

Walking to destinations

Path use for walking to destinations was measured by how many times the path segment was selected by all respondents during two trips to two different destinations on campus in the last 7 days. Fifty-one percent of the path segments were not chosen at all by the respondents during the course of two trips taken to two different destinations in the last 7 days. Most path segments (88%) were chosen 15 or fewer times. Only 5% of path segments were chosen 24 or more times (maximum: 34 times) for walking to destinations (Table B.5 in Appendix).

Figure 7.1 shows the path segments (in red) that were used by all respondents during walking trips to 2 destinations on PV in the last seven days. Indoor path segments in the RSC and village center were used for walking to destinations. A large number of outdoor path segments were also used for getting to destinations. Primarily path segments leading from the cottages to the village center and RSC were used. Surprisingly, the path segments along the perimeter of the campus (opposite side of cottages/duplexes) were also used for walking to destinations even though this route constitutes a longer route to destinations from any of the residential areas. Figure 7.2 shows the 20 path segments that were used most by residents at PV while walking to destinations. We see that path segments between the RSC and village center were used highly.

Figure 7.1: Path segments that were used (red) and not used (blue) for walking to destinations at PV

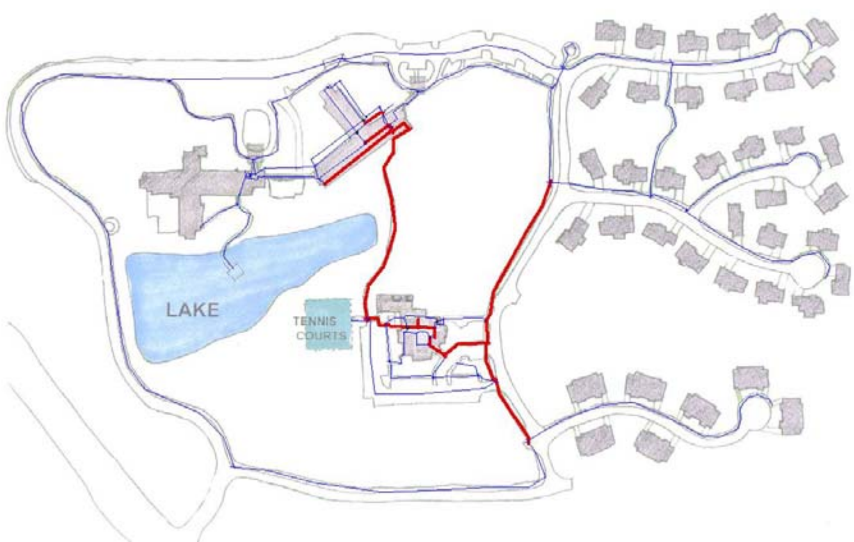


Figure 7.2: Path segments in red were used most by PV residents for walking to destinations

Walking for recreation

Path use for recreational walking was measured by the number of times the path segment was chosen by respondents during the course of their last recreational trip (indoor and outdoors) on campus in the last seven days. More than half of all path segments (57%) were not used at all by any of the respondents at PV for recreational walking. About 20% of all path segments on campus were used 1-9 times. A very small percentage of the path segments (around 5%) were chosen very often (19 or more times) during recreational walking trips on the LV campus (Table B.6).

Figure 7.3: Path segments in red were used for walking for recreation PV

Figure 7.3 shows that a majority of the path segments on campus were used for recreational walking. Almost all outdoor path segments and a large number of the indoor path segments had some use for recreation. The path segments that were not used at all (Figure 7.3 – in blue) are primarily the indoor path segments in the Village Center building.

Since the purpose of this study is to understand which aspects of path segments support their use for walking, it is helpful to classify path segments into different categories based on use. This allows us to compare the characteristics of path segments in different use categories. For the most interpretable results path segments were classified into 2 categories – those that were not chosen at all for walking (no use) versus those that were chosen once or more for walking (used for walking to destinations).

As described in the earlier chapter, it is likely that different groups of residents (e.g. those with health problems, those in the highly active category) may differ from the overall group in terms of path use. The table below summarizes path use (no use versus some use) by different types of residents for instrumental walking and recreational walking.

Table 7.2: Path use for walking overall and among different categories of residents

Path use for ….		**Getting to destinations**				**Walking for recreation**			
		Path segments that were not used at all		**Path segments that had some use**		**Path segments that were not used at all**		**Path segments that had some use**	
		N	%	N	%	N	%	N	%
Overall (n=36)		52	50	51	50	59	57	44	43
Gender	Males (n=12)	76	74	27	26	82	80	21	20
	Females (n=24)	56	54	47	46	61	59	42	41
Use of assistive device?	Yes (n=9)	70	68	33	32	72	70	31	30
	No (n=27)	57	55	46	45	60	58	43	42
Age	Below 72 (n=2)	93	90	10	10	85	83	18	17
	Between 73 and 80 (n=7)	77	75	26	25	85	83	18	17
	81 and over (n=27)	55	53	48	47	59	57	44	43
Activity Category	Insufficiently active (n=12)	68	66	35	34	72	70	31	30
	Sufficiently active (n=10)	69	67	34	33	67	65	36	35
	Highly active (n=12)	66	64	37	36	67	65	33	35
Type of residence	Cottage (n=24)	72	70	31	30	78	76	25	24
	Apartment (n=12)	60	58	43	42	69	67	34	33

The sample was almost equally divided in the physical activity category. Contrary to expectation – we would expect to see that highly active residents were using more path segments – the number of path segments used for recreational walking and the number of path segments used for instrumental walking by residents in the three physical activity categories was similar.

7.2 Environmental factors that may be related to path segment use

The environmental factors that are examined in this section include:

Local characteristics:
- Type of path segment – indoor path or outdoor path
- Length of path segment
- Location of path segment – for indoor and outdoor path segments
- Path material – indoor and outdoor path segments
- Path gradient
- Presence of street crossing in segment
- Presence of path obstruction
- Presence of steps
- Path continuity
- Number of amenities present
- Presence of destinations on path segment
- Number of destinations along path segment

Relational characteristics
- Presence of specific views from path segment
- Number of views from path segment

Global Characteristics
- Depth or centrality of path segment
- Number of routes that the path segment lies on

The relationship of each of these path characteristics with path use for getting to destinations or path use for recreation was examined.

7.2.1 Local Path Characteristics

<u>7.2.1.1 Path Type</u>

Indoor path segments constituted 57% of all path segments on the PV campus. Figure 7.4 shows the indoor (blue) and outdoor path segments (red) on campus. Indoor path segments included stairs, path segments between resident apartments in the RSC, connections between the RSC building and the HSC (nursing) building and path segments in the village center

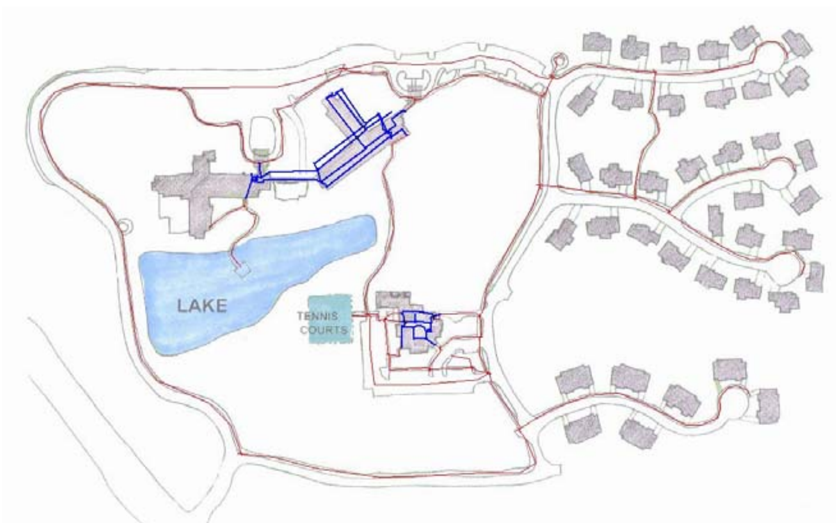


Figure 7.4: Indoor (blue) and outdoor (red) path segments on the PV campus

Research Question: Do indoor/outdoor path segments tend to be used differently for getting to destinations or for recreation?

<u>*Path use for getting to destinations*</u>

Results: Overall, when all respondents were considered, there was no difference between indoor and outdoor path segments in terms of their use in getting to destinations (p=0.2). When specific categories of residents were considered some significant relationships were observed (Table 7.3). Male residents, residents not using assistive devices, residents aged 73 to 80 years, sufficiently active residents and cottage residents used more outdoor path segments for walking to destinations as compared to indoor path segments. Cottage residents clearly used outdoor path segments more for walking to both the village center or to the dining room in the RSC buildings. Path use by the other categories of residents may be explained by the fact that most of these residents may also be cottage residents. For example, all male respondents at PV lived in cottages. The relationship is non-significant for the other resident categories (p>0.4).

Table 7.3: More outdoor path segments were used for getting to destinations on PV as compared to outdoor path segments

Segment use for getting to destinations by…	Use category	Outdoor path segment	Indoor path segment	Chi-square	p-value
Men	No use Some use	59% 41%	85% 15%	8.5	.003
Residents not using assistive devices	No use Some use	43% 57%	64% 36%	4.6	.032
Residents aged 73 to 80 years	No use Some use	59% 41%	86% 14%	9.9	.002
Sufficiently active residents	No use Some use	55% 45%	76% 24%	5.3	.02
Cottage residents	No use Some use	55% 45%	81% 19%	8.6	.003

Path use for walking for recreation

Results: Overall, a higher percentage outdoor path segments were used for recreational walking as compared to indoor path segments (Table 7.4). Almost 66% of all outdoor path segments were chosen for recreational walking at PV while only 25% of indoor path segments were chosen. Also, a larger percentage of indoor path segments as compared to outdoor path segments were not used at all for recreational walking. When subcategories of residents were considered the same was true – more outdoor path segments were used over indoor path segments for walking for all resident categories except apartment residents (p=0.058). Male residents, residents aged below 72, residents aged between 73 and 80 and cottage residents did not walk indoors for recreation.

Table 7.4: More outdoor path segments were used for walking for recreation as compared to indoor path segments

Segment use for walking for recreation by…	Use category	Outdoor path segments	Indoor path segments	Chi-square	p-value
Overall	No use Some use	34% 66%	75% 25%	16.8	.000
Men	No use Some use	52% 48%	100% 0%	35.3	.000
Female	No use Some use	39% 61%	75% 25%	13.5	.000
Residents using assistive devices	No use Some use	43% 57%	90% 10%	26.0	.000
Residents not using any assistive device	No use Some use	34% 66%	76% 24%	18.3	.000
Residents aged 72 or less	No use Some use	59% 41%	100% 0%	29.2	.000
Residents aged 73 to 80 years	No use Some use	59% 41%	100% 0%	29.2	.000
Residents aged 81 and over	No use Some use	34% 66%	75% 25%	16.8	.000
Insufficiently active residents	No use Some use	50% 50%	85% 15%	14.4	.000
Highly active residents	No use Some use	46% 54%	80% 20%	12.9	.000
Cottage residents	No use Some use	43% 57%	100% 0%	44.2	.000

7.2.1.2 Length of Path Segment

The table below (Table 7.5) shows the distribution of path segments on campus by path length (in feet). Forty nine percent of all path segments were less than 50 feet. Only 7% of the path segments were really long (over 400 feet).

Table 7.5: Distribution of path segments on PV campus by length

	Frequency	Percent	Cumulative Percent
less than 50’	50	48.5	48.5
51-100’	17	16.5	65.0
101-150’	12	11.7	76.7
151-200’	5	4.9	81.6
201-250’	2	1.9	83.5

Table 7.5: Distribution of path segments on PV campus by length

251-300’	3	2.9	86.4
301-350’	3	2.9	89.3
351-400’	4	3.9	93.2
401-450’	1	1.0	94.2
451-500’	2	1.9	96.1
over 501’	4	3.9	100.0
Total	103	100.0	

For the purpose of analysis path segments are classified as short (less than 50 feet) or long (51 feet or over). Figure 7.5 shows the distribution of path segments on the PV campus in terms of length. Sixty-eight percent of the long segments (red) were outdoor path segments. All indoor path segments between resident apartments were long. However, many of the path segments in the village center were short.

Figure 7.5: Short (blue) and long (red) path segments at PV

Research Question: Is the length of a path segment related to its being chosen for getting to destinations or for recreation?

Path use for getting to destinations

Results: The length of the segment was not related to its use for walking to destinations (p=0.06). That is, shorter path segments were no more likely than longer path segments to be used for walking to destinations at PV. This was true even when most resident level outcome variables were considered (p>0.2 for 10 categories). The only exception was path use by residents not using assistive devices (p=0.012) – they used more long path segments for walking to destinations as compared to short path segments.

Path use for recreational walking

Results: The length of the segment was related to walking for recreation. Longer path segments were chosen over shorter path segments for walking for recreation. Overall, 66% of all long path segments on campus were chosen for walking to destinations, while only 18% of short path segments were chosen. This relationship was true when all residents were considered and also when all subcategories of residents were considered (Table 7.6).

Table 7.6: More long path segments were used for recreational walking as compared to short path segments

Segment use for walking for recreation by…	Use category	Short path segments	Long path segments	Chi-square	p-value
Overall	No use Some use	82% 18%	34% 66%	24.2	.000
Male	No use Some use	98% 2%	62% 38%	20.2	.000
Female	No use Some use	84% 16%	36% 64%	24.7	.000
Residents using assistive device	No use Some use	90% 10%	51% 49%	18.6	.000
Residents not using any assistive devices	No use Some use	84% 16%	34% 66%	26.4	.000
Residents aged below 72 years	No use Some use	100% 0%	66% 34%	20.1	.000
Residents between 73 to 80 years	No use Some use	100% 0%	66% 34%	20.1	.000
Residents aged 81 years and over	No use Some use	82% 18%	34% 66%	24.2	.000
Insufficiently	No use	88%	53%	15.1	.000

Table 7.6: More long path segments were used for recreational walking as compared to short path segments

active residents	Some use	12%	47%		
Sufficiently active residents	No use Some use	94% 6%	38% 62%	35.8	.000
Highly active residents	No use Some use	88% 12%	47% 53%	19.4	.000
Cottage residents	No use Some use	96% 4%	57% 43%	21.7	.000
Apartment residents	No use Some use	84% 6%	51% 49%	12.7	.000

7.2.1.3 Location of indoor path segments

Indoor path segments at PV were categorized as:

1. Path segments between resident apartments
2. Path segments through public spaces
3. Connections between buildings
4. Indoor staircases

Table 7.7: Distribution of path segments by location inside buildings

Location of indoor path segment	Number of path segments	Percent
Path between resident apartments	7	12.5
Path through public spaces	33	58.9
Connection between buildings	2	3.6
Stair	12	21.4
other	2	3.6
Total	56	100.0

When the different types of indoor path segments were compared for difference in path use – the key difference was found to be between path segment between resident apartments and connections between buildings on one hand and other types of indoor path segments. For the purpose of analysis, path segments were grouped into two categories – a) between resident apartments and building connections and b) other types of indoor path segments.

Research Question: Are different types of indoor path segments (located in different places) used differently for walking for recreation/ getting to destinations?

Path use for getting to destinations

The location of indoor path segments was not related to their use for walking to destinations (p=0.2). This was true overall, and when path use by individual resident categories was considered (p>0.1 for all categories).

Path use for walking for recreation

Results: The location of indoor path segments was related to walking for recreation. A high percentage of the path segments located between resident apartments and connections between buildings (67%) were used for walking for recreation while only 19% of all other indoor path segments were used for walking for recreation (Table 7.10). This was found to be true for overall path use and for path use by female residents, residents not using assistive devices, residents aged 81 and over, sufficiently active residents and apartment residents. Male residents, residents aged 72 years or below, residents aged between 73 and 80 and cottage residents did not use any indoor path segments for recreation. The relationship was non significant for path use by residents using assistive devices (p=0.2), insufficiently active residents (p=0.1) and highly active residents (p=0.2).

Table 7.8: More indoor path segments between resident apartments and connections between buildings were used for recreational walking as compared to other types of indoor path segments

Segment use for walking for recreation…	Use category	Indoor path segments between resident apartments and building connections	All other indoor path segments	Chi-square	p-value
Overall	No use Some use	33% 67%	81% 19%	8.7	.003
Female	No use Some use	33% 67%	81% 19%	8.7	.003
Residents not using assistive devices	No use Some use	33% 67%	83% 17%	9.9	.002
Residents aged 81 or more	No use Some use	33% 67%	81% 19%	8.7	.003
Sufficiently active residents	No use Some use	33% 67%	87% 13%	13.0	.000
Apartment residents	No use Some use	33% 67%	81% 19%	8.7	.003

7.2.1.4 Location of outdoor path segments

There were six main categories of outdoor path segments on campus:

1. Sidewalk next to road
2. Sidewalk within 1m of kerb
3. Shared path no markings
4. Path trail through park
5. Access lane
6. Road crossover

Table 7.9: Types of outdoor path segments on PV campus

Location of outdoor path segments	Number of path segments	Percent
Sidewalk next to road	15	32.6
Sidewalk within 1m of kerb	10	21.7
Shared path, no markings	6	13.0
Path/trail through park	6	13.0
Access lane	3	6.5
path connected two building levels from outside - stairs	3	6.5
upper building level outdoor path	3	6.5
Total	46	100.0

Sidewalk segments (sidewalks next to road + sidewalks within 1m of kerb + access lane) made up a majority (54%) of the outdoor path segments on the PV campus (Table 7.9). Comparison between the six groups suggested that the main difference in terms of path use lies between sidewalk segments and other types of outdoor path segments. Thus, outdoor path segments were classified into two main categories – sidewalk segments and all other types of outdoor path segments.

Research Question: Is the location of outdoor path segments related to their use for walking for recreation/ getting to destinations?

<u>Path use for getting to destinations:</u>

Results: Location of outdoor segments was related to their use for getting to destinations. More sidewalk segments were used for getting to destinations on PV as compared to the other types of outdoor path segments (Table 7.10). This relationship was significant overall and for all the categories of residents with the exception of path use by residents 72 years and below.

Table 7.10: More sidewalk segments were used for walking to destinations as compared to other types of outdoor path segments

Segment use for walking to destination by…	Use category	Sidewalks and access lane segments	All other outdoor path segments	Chi-square	p-value
Overall	No use Some use	25% 75%	83% 17%	14.9	.000
Male	No use Some use	46% 56%	89% 11%	8.5	.004
Female	No use Some use	36% 64%	89% 11%	12.6	.000
Residents using assistive devices	No use Some use	61% 39%	94% 6%	6.5	.011
Residents not using any assistive device	No use Some use	25% 75%	83% 17%	14.9	.000
Residents between 73 to 80 years	No use Some use	43% 57%	94% 6%	12.5	.000
Residents aged 81 year and over	No use Some use	36% 64%	83% 17%	10.0	.002
Insufficiently active residents	No use Some use	46% 56%`	94% 6%	11.4	.001

Table 7.11: More sidewalk segments were used for walking to destinations as compared to other types of outdoor path segments

Sufficiently active residents	No use Some use	39% 61%	89% 11%	11.1	.001
Highly active residents	No use Some use	50% 50%	89% 11%	7.3	.007
Cottage residents	No use Some use	39% 61%	89% 11%	11.1	.001
Apartment residents	No use Some use	50% 50%	89% 11%	7.3	.007

<u>Path use for recreational walking</u>

Results: More sidewalk path segments were used for walking for recreation as compared to all other types of outdoor path segments. Overall, 86% of the sidewalk path segments were used for walking for recreation on the PV campus while only 25% of the other types of outdoor path segments were used. The relationship was significant for all categories of residents (Table 7.11).

Table 7.12: More sidewalks segments were used for recreational walking as compared to other types of outdoor path segments.

Segment use for walking for recreation by…	Use category	Sidewalks and access lane segments	All other outdoor path segments	Chi-square	p-value
Overall	No use Some use	14% 86%	75% 25%	18.8	.000
Male	No use Some use	36% 64%	83% 17%	10.0	.002
Female	No use Some use	18% 82%	83% 17%	19.1	.000
Residents using assistive devices	No use Some use	25% 75%	83% 17%	14.9	.000
Residents not using any assistive device	No use Some use	14% 86%	78% 22%	18.5	.000
Residents aged 72 years or less	No use Some use	39% 61%	94% 6%	13.9	.000
Residents between 73 to 80 years	No use Some use	43% 57%	89% 11%	9.7	.002
Residents aged 81 year and over	No use Some use	14% 86%	78% 22%	18.5	.000
Insufficiently active residents	No use Some use	32% 68%	89% 11%	14.2	.000
Sufficiently active residents	No use Some use	25% 75%	83% 17%	14.9	.000
Highly active residents	No use Some use	18% 92%	78% 22%	16.2	.000

Table 7.13: More sidewalks segments were used for recreational walking as compared to other types of outdoor path segments.

Cottage residents	No use Some use	21% 79%	83% 17%	16.9	.000
Apartment residents	No use Some use	43% 57%	89% 11%	9.7	.002

7.2.1.5 Path Material – Outdoor path segments

Most of the outdoor path segments on campus were made of continuous concrete (53%) or bitumen (27%). A small number of path segments were made of wood planks (13%) and 6% of the path segments were under repair at the time of the study.

Research Question: Is the material of which outdoor path segments are constructed related to their use for walking to destinations/walking for recreation?

Results:

Path material of outdoor path segments was not related to their use for walking to destinations ($p>0.05$) or their use for walking for recreation ($p>0.05$). This was true even when path use by all categories of residents was taken into consideration

Path Material – Indoor path segments

Most indoor path segments (66%) are carpeted. Other indoor path segments are either vinyl flooring (16%) or hardwood (18%).

Research question: Is the path material of indoor path segments related to path use for walking for recreation/getting to destinations?

Results: The path material of indoor path segments on PV was not related to path use for walking for recreation ($p>0.1$ overall and for all resident categories) or for getting to destinations ($p>0.05$ overall and for all resident categories).

7.2.1.6 Path gradient

Around 81 % of all outdoor path segments at PV were flat, 12% had moderate slope and 8% were steep. Since all indoor path segments were flat, the analysis was conducted with the set of outdoor path segments only. Many of the path segments along the perimeter and leading to the cottage cul-de-sacs are either moderately sloping or steep (Figure 7.6).

Figure 7.6: Path segments in red are moderately sloping or steep path segments, path segments in blue are flat segments

Research Question: Is path gradient of outdoor path segments related to use of path segments for walking for recreation/ getting to destinations?

Comparison among the path segments with the different types of slopes showed that the main difference in path use lay between outdoor path segments that were flat and outdoor path segments that were moderately sloping or steep. The path segments were organized into two categories for analysis – flat or steep/moderately sloping.

Path use for Walking to destinations

Results: Path gradient was related to use of path segments for walking to get to destinations at PV (p=0.036). When all residents were considered, more moderately sloping and steep path segments were used for walking to destinations as compared to flat path segments. This relationship was significant for path use by residents not using assistive devices (p=0.036), residents aged between 73 and 80 (p=0.039) and sufficiently active residents (p=0.029). The relationship was non- significant for other categories of residents (p>0.2).

Path use for recreational walking

Results: The analysis showed that a higher percentage of outdoor path segments at PV that were moderately sloping or had steep slopes were used for recreational walking at PV as compared to path segments that were flat. Overall, as many as 90% of moderately sloping or steep path segments were used for recreational walking while only 46% of the flat segments were used (Table 7.15). This was true when path use by different categories of residents was considered as well, with the exception of apartment residents (no significant difference).

Table 7.14: A higher percentage of moderately sloping and steep segments were used for recreation as compared to flat segments.

Segment use for walking for recreation by…	Use category	Flat outdoor path segments	Moderately sloping or steep outdoor path segments	Chi-square	p-value
Overall	No use Some use	54% 46%	10% 90%	9.5	.002
Male	No use Some use	75% 25%	25% 75%	10.9	.001
Female	No use Some use	63% 37%	10% 90%	12.7	.000
Residents using assistive devices	No use Some use	67% 33%	15% 85%	11.9	.001
Residents not using any assistive device	No use Some use	54% 46%	10% 90%	9.5	.002
Residents aged 72 years or less	No use Some use	83% 17%	30% 70%	12.8	.000
Residents between 73 to 80 years	No use Some use	83% 17%	30% 70%	12.8	.000
Residents aged 81 year and over	No use Some use	54% 46%	10% 90%	9.5	.002
Insufficiently active residents	No use Some use	67% 33%	30% 70%	5.8	.015

Table 7.15: A higher percentage of moderately sloping and steep segments were used for recreation as compared to flat segments.

Sufficiently active residents	No use Some use	71% 29%	15% 85%	13.7	.000
Highly active residents	No use Some use	58% 42%	10% 90%	11.0	.001
Cottage residents	No use Some use	67% 33%	15% 85%	11.9	.001

7.2.1.7 Path condition

Since there was insufficient variation between categories: 99% of all path segments on the PV campus are in good condition, this variable was excluded from the analysis.

7.2.1.8 Presence of street crossing in segment

Around 30% of all outdoor path segments on the PV campus had street crossings in them. *Research Question:* Is the presence of a street crossing within an outdoor path segment related to its use for walking for recreation/ getting to destinations?

Path use for getting to destinations

Results: The presence of a street crossing within a path segment was not related to use of path segments for walking to get to destinations at PV ($p=0.08$). This was true even when path use by subcategories of residents was considered ($p>=0.08$), with the exception of path use by cottage residents. Cottage residents used 69% of outdoor path segments *with* street crossings in them and only 36% of path segments without street crossings ($p=0.04$).

Path use for walking for recreation

Results: A higher percentage of outdoor path segments *with* street crossings in them were used for walking for recreation as compared to path segments without street crossings (Table 7.13). Outdoor path segments with and without street crossings were used no differently by female residents ($p=0.2$), residents using assistive devices ($p=0.08$), residents aged 72 years and below (p=0.07), insufficiently active residents (p=0.7), sufficiently active residents (p=0.054) and apartment residents (p=0.7).

Table 7.16: More outdoor path segments with street crossings in them were used for recreational walking as compared to outdoor path segments without street crossings

Segment use for walking for recreation by…	Use category	No street crossing	Street crossing present in segment	Chi-square	p-value
Overall	No use Some use	45% 55%	8% 92%	5.7	.017
Male	No use Some use	68% 32%	15% 85%	10.0	.002
Residents not using any assistive device	No use Some use	45% 55%	8% 92%	5.7	.017
Residents between 73 to 80 years	No use Some use	71% 29%	31% 69%	6.1	.013
Residents aged 81 year and over	No use Some use	45% 55%	8% 92%	5.7	.017
Highly active residents	No use Some use	48% 52%	8% 92%	6.5	.010
Cottage residents	No use Some use	58% 42%	8% 92%	9.5	.002

7.2.1.9 Presence of path obstructions in segment

Only 7% of path segments on the PV campus had obstructions in them. The type of obstruction in most cases was furniture located along the path.

Research Question: Are more path segments without obstructions along them used for walking for recreation or for getting to destinations as compared to path segments with obstructions?

Results: The presence of path obstructions along a path is not related to its use for walking for recreation (p=0.9 overall and p>0.3 for all resident categories) or getting to destinations (p=0.25 and p>0.1 for all resident categories).

7.2.1.10 Presence of steps in the segment

Steps were present within 11% of path segments on the PV campus.

Research Question: Is the presence of steps within a segment related to its use for walking for recreation/ getting to destinations?

Path use for getting to destinations

Results: The presence of steps within a segment was not related to its use for walking to destinations ($p=0.8$). This was true when path use by different categories of residents was considered ($p>0.3$ for most categories and $0.05<p<0.1$ for 2 categories).

Path use for recreational walking

Results: The presence of steps within a path segment was related to its use for walking for recreation. More path segments without steps were used as compared to path segments with steps for recreational walking at PV (Table 7.14). A higher percentage of path segments *without* steps were used overall for recreational walking and by female residents, residents not using any assistive devices, residents aged 81 years and above, insufficiently active residents, sufficiently active residents and cottage residents. The same trend was observed for path use by other resident categories through the relationship was non-significant ($p>0.075$).

Table 7.17: More path segments without steps were used for recreational walking as compared to path segments with steps.

Segment use for walking for recreation by…	Use category	Path segments without steps	Path segments with steps	Chi-square	p-value
Overall	No use Some use	53% 47%	91% 9%	5.7	.017
Female	No use Some use	55% 45%	91% 9%	5.1	.024
Residents not using any assistive device	No use Some use	53% 47%	100% 0%	8.8	.002

Table 7.18: More path segments without steps were used for recreational walking as compared to path segments with steps.

Residents aged 81 and over	No use Some use	53% 47%	91% 9%	5.7	.017
Insufficiently active residents	No use Some use	66% 34%	100% 0%	5.3	.021
Sufficiently active residents	No use Some use	61% 39%	100% 0%	6.6	.010
Cottage residents	No use Some use	72% 28%	100% 0%	3.9	.047

7.2.1.10 Path Continuity

A majority of the path segments on campus (89%) formed direct and useful routes (Figure7.7). Relatively few path segments were disjointed

Figure 7.7: Path segments in blue are disjointed path segments on the PV campus

Research question: Are more path segments that form useful and direct routes used for recreation or for getting to destinations as compared to path segments that are disjointed?

Path use for getting to destinations:

Results: Disjointed path segments were not used at all for walking to destinations. This is true for overall path use and when path use by individual categories of residents is considered. There was a significant relationship between path continuity and path use for getting to destination. A higher percentage of continuous path segments were used for getting to destinations as compared to disjointed path segments. This was true for all categories of residents, except residents aged below 72 years (Table 7.15).

Table 7.19: A higher percentage of direct path segment were used for walking to destinations as compared to disjointed path segments

Segment use getting to destinations by…	Use category	Path segment forms direct and useful route	Path segment is disjointed	Chi-square	p-value
Overall	No use Some use	45% 55%	100% 0%	12.0	.001
Men	No use Some use	71% 29%	100% 0%	4.4	.036
Female	No use Some use	49% 51%	100% 0%	10.3	.001
Residents using assistive devices	No use Some use	64% 36%	100% 0%	5.8	.016
Residents not using any assistive device	No use Some use	50% 50%	100% 0%	9.9	.002
Residents aged 73 to 80 years	No use Some use	72% 28%	100% 0%	4.1	.041
Residents aged 81 and over	No use Some use	48% 52%	100% 0%	10.7	.001
Insufficiently active residents	No use Some use	62% 38%	100% 0%	6.3	.012
Sufficiently active residents	No use Some use	63% 37%	100% 0%	6.0	.014
Highly active residents	No use Some use	60% 40%	100% 0%	6.9	.009
Cottage residents	No use Some use	66% 34%	100% 0%	5.3	.021
Apartment residents	No use Some use	53% 47%	100% 0%	8.8	.003

Path use for walking for recreation: There was no significant difference in path use between path segments that are disjointed and those that are continuous (p=0.08). This was also true when path use by different resident categories was considered

($0.057<p<0.5$). However, even though the relationship was not significant we do see that more continuous segments were chosen for recreational walking as compared to disjointed path segments.

7.2.1.11 Number of amenities present

Fifty-four percent of the path segments on the PV campus had no amenities (benches, water fountains, handrails) along them.

Research question: Is the presence of one or more amenities on a path segment related to its use for walking for recreation/getting to destinations?

Results: The presence of amenities along a path segment was not related to its use walking to destinations ($p=0.8$ and $p>0.2$ for all resident categories) or for recreation ($p=0.7$ overall and $p>0.059$ for all resident categories).

7.2.1.12 Presence of destinations on Path Segments

Activity related areas were found along 27% of the path segments on the PV campus, residential areas on 21%, administrative areas on 15% and parking areas along 6% of path segments. Natural destinations (pond, gazebo) were found only on 3% of path segments on PV. Since shops, chapels and natural destinations were found on fewer than 5% of path segments, these destinations were not included in the analysis.

Research Question: Is the presence of a specific destination on a path segment related to its use for walking to destinations/ walking for recreation?

Path use for walking to destinations

Residential areas

More path segments with residences along them were used for recreational walking as compared to path segments without residences along them. This was only true for overall path use and for path use by residents not using any assistive devices and for sufficiently active residents. This relationship was not significant for other categories of residents ($p>0.2$).

Table 7.20: More path segments with residences along them were used for walking to destinations on PV.

Segment use for walking to destinations by…	Use category	No residential destinations along segment	Residential destination present along path segment	Chi-square	p-value
Overall	No use Some use	57% 43%	27% 73%	6.0	.014
Residents not using any assistive device	No use Some use	62% 38%	32% 68%	6.2	.012
Sufficiently active residents	No use Some use	73% 27%	46% 54%	5.8	.015

Activity-related areas

The presence of activity related areas was not related to path use for walking to destinations ($p=0.34$). This was true overall and for categories of residents ($p>0.1$ for all categories and $p=0.53$ for apartment residents).

Administrative areas

The presence of administrative areas was not related to path use for walking to destinations. This was true overall ($p=0.2$) and for most categories of residents ($P>=0.057$), with the exception of residents aged 72 years and below ($p=0.016$), insufficiently active residents ($p=0.02$) and apartment residents ($p=0.034$). More path segments with administrative areas along them were used by these residents for walking to destinations.

Parking

Path segments with parking areas along them were used no differently from path segments without parking areas for walking to destinations at PV (p=0.98). This was true even when only outdoor path segments were included in the analysis and when path use by different categories of residents was considered (p>0.3).

<u>Path use for walking for recreation</u>

Residential areas

A higher percentage of path segments which had residences along them were used for recreation as compared to path segments without residences along them. This relationship was significant for overall path use and for path use by most categories of residents. The exceptions are path use by insufficiently active residents and apartment residents (Table 7.30).

Table 7.21: More path segments with residences along them were used for recreational walking

Segment use for walking for recreation by…	Use category	No residential destinations present	Residential destination present	Chi-square	p-value
Overall	No use Some use	67% 33%	23% 77%	13.7	.000
Male	No use Some use	85% 15%	59% 41%	7.3	.007
Female	No use Some use	69% 31%	23% 77%	15.4	.000
Residents using assistive devices	No use Some use	78% 22%	41% 59%	11.1	.001
Residents not using any assistive device	No use Some use	68% 32%	23% 77%	14.5	.000
Residents aged 72 years or less	No use Some use	88% 12%	64% 36%	6.9	.009
Residents between 73 to 80 years	No use Some use	88% 12%	64% 36%	6.9	.009
Residents aged 81 year and over	No use Some use	67% 33%	23% 77%	13.7	.000
Sufficiently active residents	No use Some use	74% 26%	32% 68%	13.5	.000
Highly active residents	No use Some use	75% 25%	36% 64%	11.9	.001
Cottage residents	No use Some use	80% 20%	59% 41%	4.2	.040

Activity-related areas

Path segments with activity-related areas were used no differently for recreational walking on PV from path segments with no activity related areas along them (p=0.38). This was true when path use by all residents was considered and when path use by categories of residents was considered (p>0.057).

Administrative areas

Path segments with administrative-related areas were used no differently for recreational walking on PV from path segments with no administrative-related areas along them. This was true when path use by all residents was considered (p=0.4) and when path use by most categories of residents was considered, with the exception of residents using assistive devices (p=0.032), highly active residents (p=0.019) and cottage residents (p=0.018). These categories of residents used more path segments *without* administrative areas along them for recreational walking.

Parking

Path segments with parking areas were used no differently for recreational walking on PV from path segments with no activity related areas along them (p=0.22). This was true when path use by all residents is considered and when path use by categories of residents was considered (p>0.7).

7.2.1.13 Number of destinations on path segments

Forty-one percent of the path segments on the PV campus have no destinations along them. The rest have one or more destinations along them. The key distinction appears to be between path segments that have some destinations versus path segments that have no destinations. For purpose of analysis, two categories were created – no destinations and one or more destinations (Figure 7.8).

Figure 7.8: Path segments with one or more destinations (red) and no destinations (blue) along them

Research question: Are more path segments with destinations along them used for walking for recreation/getting to destinations as compared to path segments with no destinations?

<u>*Path use for walking to destinations*</u>

There was no difference between path segments with and without destinations in terms of their use for getting to destinations on the PV campus (p=0.13). This was true when path use by most categories of residents was also considered (p>0.09), with the exception of path use by sufficiently active residents (p=0.012). These residents used more path segments with one or more destinations along them.

<u>*Path use for walking for recreation*</u>

There was no difference between path segments with and without destinations in terms of their use for walking for recreation on the PV campus (p=0.43). This was true when path use by different categories of residents was also considered (p>0.2 for all categories).

7.2.2 Relational Path Characteristics

7.2.2.1 Number of views

Three or more different types of views can be seen from 52% of the path segments on the PV campus. Less than two different types of views can be seen from the rest of the path segments.

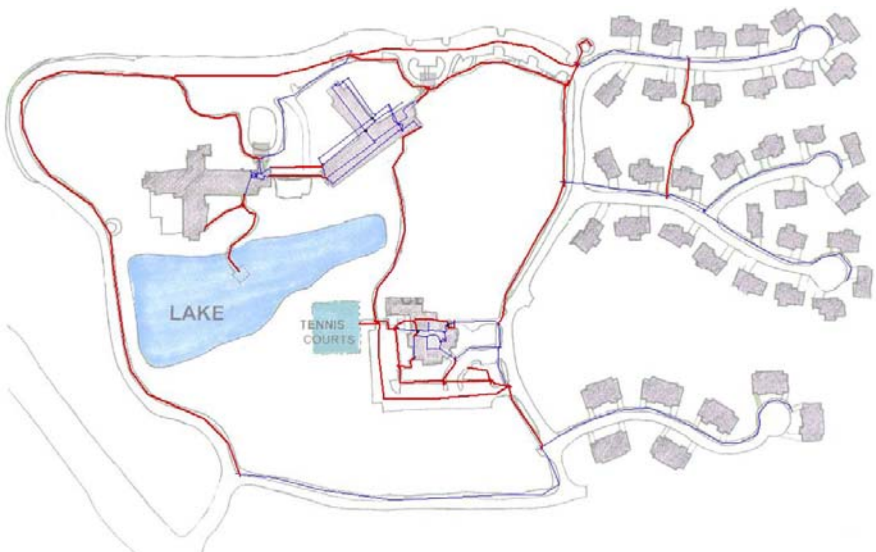


Figure 7.9: Path segments with many views (red) and few views (blue)

Research Question:

Are more path segments, from which many different views can be seen, used for walking for recreation/to get to a destination as compared to path segments with few or no views?

Path use for walking to destinations:

Path segments with more views were used no differently from path few or no views while walking to destinations on the PV campus (p=0.62). This was also true when path use by categories of residents was considered (p> 0.4 for nine categories and 0.08<p<0.18 for three categories).

Path use for walking for recreation

A higher percentage of path segments with many views (52%) were used for recreational walking as compared to path segments with no or few views (33%) (Table 7.18). When path use by categories of residents was considered, the number of views from the path segment was related to path use for recreation by most categories of residents except: female residents, residents aged below 72 years and apartment residents.

Table 7.22: More path segments from which many different types of views could be obtained were used for recreational walking

Segment use for walking for recreation by…	Use category	Path segments with few views	Path segments with many views	Chi-square	p-value
Overall	No use Some use	67% 33%	48% 52%	3.9	.049
Male	No use Some use	90% 10%	70% 30%	5.9	.015
Residents using assistive devices	No use Some use	82% 18%	59% 41%	6.1	.013
Residents not using assistive devices	No use Some use	69% 31%	48% 52%	4.7	.029
Residents aged 73 to 80	No use Some use	92% 8%	74% 26%	5.6	.018
Residents aged 81 and over	No use Some use	67% 33%	48% 52%	3.9	.049
Insufficiently active residents	No use Some use	80% 20%	61% 39%	4.2	.041
Sufficiently active residents	No use Some use	76% 24%	56% 44%	4.5	.034
Highly active residents	No use Some use	82% 18%	54% 46%	9.1	.003
Cottage residents	No use Some use	90% 10%	63% 37%	10.1	.002

7.2.2.2 Types of views

Views of residential areas were the most common (56%) view from along path segments on the PV campus. Many of the path segments on PV had views to landscaped areas on campus (47%) and to destinations not on the path, but visible from the path (46%) (Table 7.19). Other types of views that were common include views of art, public spaces, parking, untended nature (e.g. forested areas) and water. As many as 16% of the path segments do not have any of the views listed in the table (Table 7.19).

Table 7.23: Number of path segments with different types of views

Type of View	Number of path segments with view	%
Residential	58	56%
Tended nature	48	47%
Destinations (not on path)	47	46%
Art	30	29%
Public spaces	28	27%
Parking	24	23%
Untended nature	23	22%
Water (river, lake)	17	17%
No views	16	16%

Figure 7.10: Path segments with views to residences (red)

Figure 7.11: Path segments in red have views to landscaped nature

Research Question:

Are more path segments from which specific types of views can be seen used for walking for recreation/to get to a destination as compared to path segments from which this view cannot be obtained?

Results:

<u>Path use for getting to destinations</u>

The presence of any type of view - residential areas (p=0.089), tended nature (0.6), untended nature (p=0.1), destinations not on path (p=0.5), public spaces (p=0.6), art (p=0.6), parking (p=0.6) and water (p=0.2) - was not related to path use for walking to destinations.

<u>Path use for recreational walking</u>

Views to water (p=0.4), untended nature (p=0.13), public places (p=0.4), art (p=0.2) or other destinations not on path (p=0.7) from path segments was not related to path use for recreational walking. That is, path segments with these views were used no differently from path segments without these views. However, more path segments with views to residential areas, tended nature and parking were used for walking for recreation as compared to path segments without these views.

Views to residential areas

More path segments with views to residential areas were used for recreational walking as compared to path segments without views to residential areas (Table 7.20). This relationship was significant for overall path use and for path use by all categories of residents without exception.

Table 7.24: More path segments with views to residential areas were used for recreational walking

Segment use for walking for recreation by…	Use category	Path segments with no view of residential areas	Path segments with views of residential areas	Chi-square	p-value
Overall	No use Some use	84% 16%	36% 64%	24.0	.000
Male	No use Some use	100% 0%	64% 36%	20.0	.000
Female	No use Some use	84% 16%	40% 60%	21.0	.000
Residents using any assistive devices	No use Some use	91% 9%	53% 47%	17.1	.000
Residents not using any assistive device	No use Some use	87% 13%	36% 64%	26.5	.000
Residents aged 72 or less	No use Some use	100% 0%	69% 31%	16.9	.000
Residents aged 73 to 80	No use Some use	100% 0%	69% 31%	16.9	.000
Residents aged 81 or over	No use Some use	84% 16%	36% 64%	24.0	.000
Insufficiently active residents	No use Some use	87% 13%	57% 43%	10.7	.001
Sufficiently active residents	No use Some use	91% 9%	45% 55%	23.7	.000
Highly active residents	Some use Some use	91% 9%	48% 52%	21.0	.000
Cottage residents	No use Some use	98% 2%	59% 41%	21.1	.000
Apartment residents	No use Some use	84% 16%	53% 47%	11.0	.001

Views to tended nature

More path segments with tended (landscaped) nature views were used for walking for recreation as compared to path segments without those views (Table 7.21). This was true even when path use by different resident categories was considered. The relationship is non-significant for path use by apartment residents – path segments without views of tended nature were used no differently from path segments with views of tended nature.

Table 7.25: More path segments with views to tended nature were used for recreational walking

Segment use for walking for recreation by…	Use category	Path segments with no view of tended nature	Path segments with views of tended nature	Chi-square	p-value
Overall	No use Some use	75% 25%	38% 62%	14.4	.000
Male	No use Some use	98% 2%	58% 42%	25.0	.000
Female	No use Some use	75% 25%	42% 58%	11.5	.001
Residents using any assistive devices	No use Some use	89% 11%	48% 52%	20.6	.000
Residents not using any assistive device	No use Some use	76% 24%	38% 62%	15.9	.000
Residents aged 72 or less	No use Some use	98% 2%	65% 35%	20.1	.000
Residents aged 73 to 80	No use Some use	98% 2%	65% 35%	20.1	.000
Residents aged 81 or over	No use Some use	75% 25%	38% 62%	14.4	.000
Insufficiently active residents	No use Some use	86% 14%	52% 48%	13.6	.000
Sufficiently active residents	No use Some use	80% 20%	48% 52%	11.6	.001
Highly active residents	Some use Some use	89% 11%	42% 58%	26.0	.000
Cottage residents	No use Some use	98% 2%	50% 50%	32.4	.000

Views to parking

More path segments with views to parking at PV were used for recreational walking as compared to path segments without these views. This was true for overall path use and for path use for recreation by male residents, residents not using any assistive devices, residents aged 81 and over, insufficiently active residents, highly active residents, cottage residents and apartment residents (Table 7.22). The relationship was not significant for the other categories of residents (p>0.05).

Table 7.26: More path segments with views to parking were used for recreational walking

Segment use for walking for recreation by…	Use category	Path segments with no view of parking	Path segments with views of parking	Chi-square	p-value
Overall	No use Some use	63% 37%	38% 62%	5.0	.025
Male	No use Some use	85% 15%	63% 37%	5.6	.018
Residents not using any assistive device	No use Some use	65% 35%	38% 62%	5.5	.019
Residents aged 81 or over	No use Some use	63% 37%	38% 62%	5.0	.025
Insufficiently active residents	No use Some use	77% 23%	46% 54%	8.6	.003
Highly active residents	Some use Some use	73% 27%	46% 54%	6.3	.012
Cottage residents	No use Some use	82% 18%	54% 46%	7.9	.005
Apartment residents	No use Some use	73% 27%	46% 54%	6.3	.012

7.2.3 Global Path Segment Characteristics

7.2.3.1 Depth

The depth between two segments is the minimum number of spaces that must be traversed to go from one to the other. This variable is a measure of centrality of a path segment with respect to the network of path segments . The site plan of PV (Figure 7.12) shows a gradient of depth values (from red to purple to blue) where red indicates path segments that were the most central within the network of path segments on campus while blue path segments were the least central. The path segments along the perimeter of the campus were the most central while indoor path segments in the RSC and village center and outdoor path segments leading to the cottages were less central (Figure 7.12). For the purpose of analysis depth values were collapsed into two main categories around the mean – more central and less central.

Figure 7.12: A gradient from most central (red) to least central (blue) path segments on the PV campus

Research question: Are more path segments that are central within the campus network used for walking for recreation/getting to destinations as compared to path segments that are less central?

Path use for getting to destinations

Results: More path segments that are more central within the path segment network at PV were used for walking to destinations as compared to path segments that were less central within the network. Overall, 69% of more central path segments were used for walking to destinations while only 29% of the less central path segments were used (Table 7.23). The relationship was not significant for residents using assistive devices, residents aged 72 and below, residents aged 73 to 80 years, and cottage residents.

Table 7.27: More central path segments were used for walking to destinations at PV

Segment use for walking to destinations by….	Use category	Less central path segments	More central path segments	Chi-square	p-value
Overall	No use Some use	71% 29%	31% 69%	16.3	.000
Male	No use Some use	86% 14%	62% 38%	8.1	.001
Female	No use Some use	73% 27%	37% 63%	13.5	.000
Residents not using any assistive device	No use Some use	77% 23%	35% 65%	18.2	.000
Residents aged 81 or over	No use Some use	77% 23%	31% 69%	21.6	.000
Insufficiently active residents	No use Some use	80% 20%	52% 48%	9.3	.002
Sufficiently active residents	No use Some use	78% 22%	56% 44%	5.9	.014
Highly active residents	Some use Some use	77% 23%	52% 48%	6.7	.009
Apartment residents	No use Some use	77% 23%	40% 60%	13.7	.000

Path use for walking for recreation

Results: More path segments that were central within the campus network were used for walking for recreation as compared to path segments that are deeper less central. This was true for overall path use and for path use by different categories of residents with no exception (Table 7.24).

Table 7.28: A higher percentage of less central path segments were used for walking for recreation at PV

Segment use for walking for recreation by…	Use category	Less central path segments	More central path segments	Chi-square	p-value
Overall	No use Some use	80% 20%	35% 65%	22.0	.000
Male	No use Some use	92% 8%	67% 33%	9.8	.002
Female	No use Some use	80% 20%	39% 61%	18.7	.000
Residents using any assistive devices	No use Some use	84% 16%	56% 44%	9.9	.002
Residents not using any assistive device	No use Some use	82% 18%	35% 65%	24.1	.000
Residents aged 72 or less	No use Some use	92% 8%	73% 27%	6.5	.011
Residents aged 73 to 80	No use Some use	94% 6%	71% 29%	9.1	.002
Residents aged 81 or over	No use Some use	80% 20%	35% 65%	22.0	.000
Insufficiently active residents	No use Some use	88% 12%	52% 48%	16.1	.000
Sufficiently active residents	No use Some use	84% 16%	46% 54%	16.5	.000
Highly active residents	Some use Some use	82% 18%	52% 48%	10.7	.001
Cottage residents	No use Some use	86% 14%	65% 35%	6.1	.013
Apartment residents	No use Some use	88% 12%	46% 54%	20.6	.000

7.2.3.2 Choice (betweenness centrality)

This is a measure of how many times a path segment will be found lying on routes connecting two points in the system. That is, the number of routes that the path segment is potentially a part of in the system of path segments on campus. Twelve percent of all path segments did not lie between any two path segments – that is they formed a dead end. Path segments were distributed into two categories about the median – low choice and high choice. Indoor path segments on the first and second floor of the RSC were found lying on many routes (high choice). Outdoor path segments along the perimeter of the campus and between the RSC and village center were also high choice path segments (Figure 7.13)

Research question: Are path segments that lie on many routes on campus likely to be used more for instrumental/ recreational walking?

Figure 7.13: High choice (red) and low choice (blue) path segments at PV

Path use for walking to destinations

Results: Path segments that lay on many routes connecting path segments on campus (high choice) were used more for walking to destination at PV as compared to path segments that lay on few routes (low choice) (Table 7.25). This was also true for path use by most categories of residents with the exception of residents using assistive devices, residents below 72 years and highly active residents.

Table 7.29: Path segments that were part of more routes on campus were used more for walking to destinations

Segment use for walking to destinations by…	Use category	Path segments with few or no choices	Path segments with many choices	Chi-square	p-value
Overall	No use Some use	65% 35%	35% 65%	9.3	.002
Male	No use Some use	87% 13%	61% 39%	8.8	.003
Female	No use Some use	69% 31%	39% 61%	9.3	.002
Residents not using any assistive devices	No use Some use	75% 25%	35% 65%	16.4	.000
Residents between 73 to 80 years	No use Some use	85% 15%	65% 35%	5.4	.020
Residents aged 81 and over	No use Some use	69% 31%	37% 63%	10.5	.001
Insufficiently active residents	No use Some use	87% 13%	45% 55%	19.7	.000
Sufficiently active residents	No use Some use	79% 21%	55% 45%	6.7	.010
Cottage residents	No use Some use	81% 19%	59% 41%	5.9	.015
Apartment residents	No use Some use	73% 27%	43% 57%	9.5	.002

Path use for walking for recreation

Results: There was a relationship between choice and walking to recreation at PV. A higher percentage of high choice path segments were used for walking for recreation as compared to low choice path segments (Table 7.26). This relationship was true when overall path use was considered and when path use by different resident categories was considered. The relationship was not significant for path use by male residents and cottage residents.

Table 7.30: More path segments that were part of many routes on campus were used for recreation.

Segment use for walking for recreation by…	Use category	Path segments with few choices	Path segments with many choices	Chi-square	p-value
Overall	No use Some use	71% 29%	43% 57%	8.3	.004
Female	No use Some use	73% 27%	45% 55%	8.3	.004
Residents using assistive devices	No use Some use	81% 19%	59% 41%	5.9	.015
Residents not using any assistive devices	No use Some use	73% 27%	43% 57%	9.5	.002
Residents aged 72 or less	No use Some use	90% 10%	75% 25%	4.5	.034
Residents between 73 to 80 years	No use Some use	90% 10%	75% 25%	4.5	.034
Residents aged 81 and over	No use Some use	71% 29%	43% 57%	8.3	.004
Insufficiently active residents	No use Some use	87% 13%	53% 47%	13.8	.000
Sufficiently active residents	No use Some use	77% 23%	53% 47%	6.5	.011
Highly active residents	No use Some use	77% 23%	57% 43%	4.7	.03
Apartment residents	No use Some use	83% 17%	51% 49%	11.7	.001

7.3 Analysis of high-use path segments for recreation

In order to understand if there was a difference between different groups of residents in terms of path segments that were highly used for recreational walking, the twenty high use path segments (for recreation) by different resident categories were identified and compared.

Overall path use for recreation

The path segments in red (figure 7.14) are the 20 path segments used most by PV residents for walking for recreation on campus. The outdoor path segments running along the perimeter of the campus were used highly for recreational walking as well as the path segments leading to the cottages. Indoor path segments on the first and second floor along the long corridor leading to the HSC (nursing) building were also used a lot for recreation.

Figure 7.14: Path segments in red are used most for recreational walking at PV

Gender

Both male and female residents walked along the campus perimeter for recreation. The key difference in use of path segments between males and females was that female residents also walked indoors in the RSC for recreation (Figure 7.16) while male residents did not (Figure 7.15). Also male residents walked a lot along the path segments by the cottages while female residents did not. It should be noted that the path segments leading to the top of the cottage cul-de-sacs were quite steep.

Figure 7.15: Path segments in red were used most by male residents for recreational walking

Figure 7.16: Path segments in red were used most by female residents for recreational walking

Use of assistive device

Residents using assistive devices (Figure 7.17) and those not using assistive devices (Figure 7.18) used a similar set of path segments often for recreational walking. Residents not using assistive devices walked more indoors.

Figure 7.17: Path segments in red were used most by residents using assistive devices

Figure 7.18: Path segments in red were used most by residents not using any assistive devices

Age

Residents in all three age groups chose to walk along the perimeter of the campus. We see that the residents below 72 (Figure 7.19) and the residents aged 73 to 80 (Figure 7.20) also chose to walk up the hill to the cottages for recreation. Residents over 81 did not use those path segments highly for recreation (Figure 7.21). They did however walk indoors in the RSC for recreation, unlike the other two age groups. Where the residents choose to walk (indoors versus by the cottages) may also be related to where they live. Most of the residents in the two younger age groups live in cottage or cluster homes, while many of the oldest residents live in apartments.

Figure 7.19: Path segments in red were used most for recreation by residents aged below 72

Figure 7.20: Path segments in red were used most for recreation by residents aged 73 to 80

Figure 7.21: Path segments in red were used for recreation by residents aged 81 and over

Physical activity level

There is not much difference in the set of path segments that were highly used by insufficiently active (Figure 7.22) and sufficiently active PV residents (Figure 7.23). Both categories of residents use both indoor and outdoor path segments for recreation. However, the highly active residents tended to use only outdoor path segments most for recreation (Figure 7.24). They walked along the perimeter of the campus and up the hills to the cottages.

Figure 7.22: Path segments in red are used most by insufficiently active residents

Figure 7.23: Path segments in red are used most by sufficiently active residents

Figure 7.24: Path segments in red are used most by highly active residents

Type of residence

The path segments that were used highly by cottage/cluster residents include the outdoor path segments along the perimeter of the campus and the path segments by the cottages and cluster homes (Figure 7.25). No indoor path segments were used highly by this category of residents. The path segments that were used highly by apartment residents were indoor path segments on the first and second floor of the RSC and outdoor path segments clustered close to the RSC building – leading from the nursing building to the village center and the path segment (short cut) leading from the RSC building to the village center (Figure 7.26).

Figure 7.25: Path segments in red were used most for recreation by cottage residents

Figure 7.26: Path segments in red were used most for recreation by apartment residents

7.4 Analysis of highly used recreation routes

Outdoor Routes

Four main routes were used for walking for recreation at PV. In some cases, residents combined two or more routes during their walk. A few residents also used linear routes - this category includes walks that were taken from A to B and back to A along the same route. There was no commonly used route for such walks. The origin of the linear route depended on the location of the respondent's residence.

Table 7.31: Number of residents using different types of routes at PV

Number of residents that used route…		Only Route 1	Only Route 2	Only Route 3	Only Route 4	Combination routes	Linear routes	Indoor route
Age	72 years or less	0	0	0	0	2	0	0
	73-80 years	1	0	0	0	3	1	0
	81 years and over	8	0	1	2	2	4	5
Gender	Male	3	0	1	0	3	1	0
	Female	6	0	0	2	4	5	8
Type of residence	Apartment	1	0	0	2	1	3	8
	Cottage	8	0	1	0	6	3	0
Use assistive device for walking?	No	8	0	0	2	5	4	7
	Yes	1	0	1	0	2	2	1
Physical activity level (based on IPAQ)	Insufficiently active	2	0	0	1	1	3	2
	Sufficiently active	2	0	1	1	0	2	4
	Highly active	4	0	0	0	6	1	1

Route 1: Residents who took this route walked along the perimeter of the campus. This was a fairly long walk –around 0.85 mile long (Figure 7.27). There were variations in gradient along the route – the path segments by the Village Center and leading up to the RSC building were relatively flat. The path leading from the RSC to the nursing building had a moderate slope, while the path leading from the Village Center in the direction of the front campus entrance had a steep uphill slope. There are sidewalks all along this route – concrete paved in some places and bitumen in others. Beautiful views of the campus buildings, lake and natural features could be seen from most points along this

path. This is by far, the most popular route on campus – sixteen residents in total walked this route for recreation (Table 7.42). Of these, nine residents chose to walk only along route 1, three residents combined route 1 with route 2, three residents combined route 1 and route 3 and one resident combined route 1 and route 4.

Reasons given for choosing this route included exercise (distance walked), fun, presence of sidewalk throughout and attractive views. Majority of the residents using this route did not use assistive devices (8 out of 9) and many were classified as highly active (4 out of 8), though insufficiently active and sufficiently active residents also used this route. However, of the 16 residents who walked this route, as many as ten were 81 years or older.

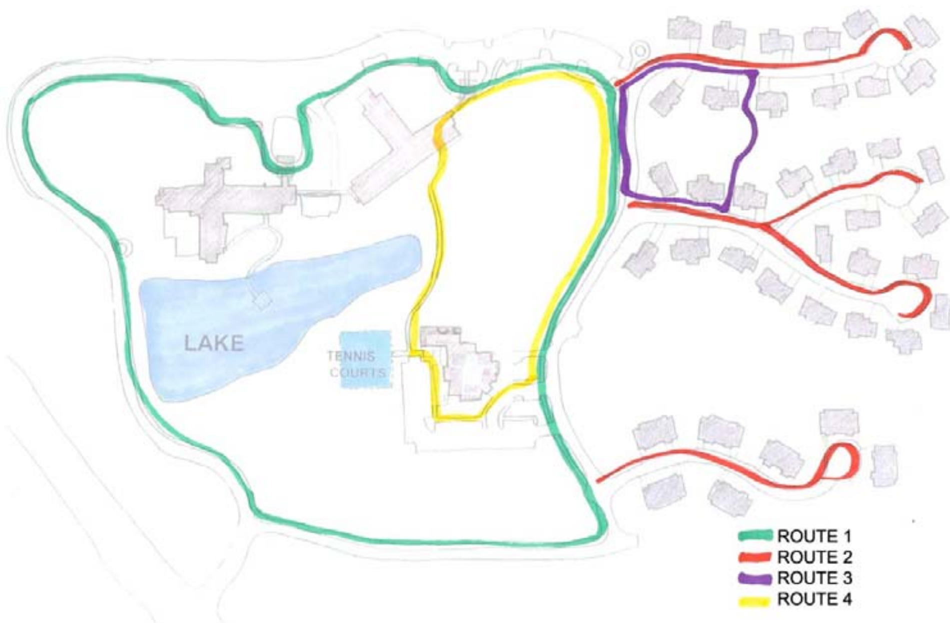


Figure 7.27: Highly used recreation routes at PV

Route 2: This route involved walking up and back down the streets leading to the cottage homes' cul-de-sac (Figure 7.27). Only three residents walked this route and all combined this route with route 1. The roads leading up to the cottages are quite steep. There are sidewalks on one side of the road. The presence of hills was given as a reason for choosing this route. This route was only used for recreation in combination with one of the other routes. All residents who included this route within their walk were highly active.

Route 3: This is a small looped route (0.2 mile) in the corner of the campus between the cottage homes (Figure 7.27). A narrow landscaped path segment crosses over a creek between the two streets. This path segment is almost a hidden secret on campus. It can hardly be seen as one walks or drives up the street to the Cottage homes. This is also explained by the fact that this segment is located deep within the network of path segments at PV and is also a low choice segment. Only four residents used this path segment for recreation and two of these three residents combined route 3 with route 1 (Table 7.42). All the residents who used this route lived in the cottages.

Route 4: This route involved walking along the nature trail between the RSC and Village Center, through the Village Center (or the VC parking lot) and up the sidewalks back to the RSC (Figure 7.27). This is an attractive route with views to the campus and lake and is along path segments that are central within the campus. However, only three residents used this route, two of whom combined this route with route 1. One possible reason why this was not used much may be due to the fact that residents needed to take the stairs/elevators in the RSC building and the Village Center to complete this route. Also, even though attractive views of the lake can be seen from the nature trail, there is no way of getting closer to the lake other than by walking on the grass. Only apartment residents used this route – possibly because the only way to get to this route is from the Village Center or from the RSC building.

Indoor routes – the most popular indoor route was walking along the resident corridors on the first or second floor and through the covered indoor connection to the HSC and back (a little less than 0.2 mile). The corridor connection between the buildings in particular is quite attractive with views of the lake and Village Center. Around seven residents, all living in the RSC, walked along the indoor route (Table 7.42).

7.5 Summary of PV Case Study

Path use for walking to destinations

The results show that a higher percentage of outdoor path segments were used for walking to destinations on the PV campus as compared to indoor path segments. However, this relationship was not true for overall path use. This was only true for male residents, residents not using any assistive devices, residents aged 73 to 80 years, sufficiently active residents and cottage residents. At PV, some destinations are located in the residential apartment building (e.g. the dining room) and most other destinations are located in a separate village center building. Further, a majority of the respondents (and a majority of the residents at PV) live in cottages and cluster homes that are not physically connected to either the RSC or the Village Center. Thus, many of the residents need to walk outdoors to reach destinations. During informal discussions with residents, the lack of a covered connection between the RSC building and the Village Center was mentioned as an obstacle to greater use of the programs available there.

Indoor path segments at different locations (between resident apartments, through public places etc) are used no differently. However, the location of outdoor path segments at PV is related to path use for walking to destinations. Path segments that are sidewalks along roads are used more for walking to destinations as compared to other types of outdoor path segments (Table 7.43).

The length of the path segment does not matter – that is, longer path segments are used no differently from shorter path segments for walking to destinations at PV. Other local path characteristics that are not related to path use for walking to destinations include material used to construct path segments (indoor and outdoor), presence of street crossing in path segments, presence of path obstructions, presence of steps, path gradient (slope) and presence of amenities along the path segment.

The presence of destinations along a path segment was not related to its use for walking to destinations at PV. However, more path segments with residences located along them were used for walking to destinations. This was true for overall path use and for path use by residents not using assistive devices and sufficiently active residents.

Path segments from which more types of views can be obtained were used no differently from path segments with none or few views at PV. Also, the presence of any specific type of view – such as a view of water, or nature- from the path segment was also not related its use for walking to destinations on the PV campus.

Global structural path characteristics are related to path use for walking to destinations at PV. More path segments that are central within the campus network are used for walking to destinations as compared to path segments that are less central. The choice afforded by a path segment as a consequence of its location within the system of path segments also seems to matter. A higher percentage of path segments that lay on many routes connecting other path segments were used for walking to destinations as compared to path segments that lay on few or no routes connecting segments. It is also important to note that these two structural path characteristics are also related to each other (chi square = 27.3; p=0.000). That is, 75% of the high choice path segments at PV were also more central path segments.

Path use for walking for recreation

Local, relational and global environmental characteristics are related to path segments being used for recreation. The analysis shows that a higher percentage of outdoor path segments were used for recreation as compared to indoor path segments. Among outdoor path segments, a higher percentage of path segments that were sidewalks along the side of the road or access roads were used for recreational walking as compared to other types of outdoor path segments. However, it is interesting to note that many of the indoor path segments, especially path segments between resident apartments were also used for recreational walking. The analysis shows that a higher percentage of indoor path segments between resident apartments and connections between buildings were used as compared to other types of indoor path segments for recreational walking.

The length of path segments is related to their use for recreational walking. A higher percentage of long path segments were chosen for recreational walking as compared to shorter path segments and this is true for all categories of residents.

The gradient of outdoor path segments is related to their use for recreational walking at PV. A higher percentage of moderately sloping and steep path segments were used for recreational walking as compared to flat path segments. This is true for overall path use and path use by all categories of residents (with the exception of apartment residents). This is somewhat contrary to expectation, as we would have expected many of the elderly residents, especially older residents and those using assistive devices to choose level path segments for walking. Perhaps, active residents seek out challenging paths with steep or moderately sloping gradients.

Another unexpected finding is that more path segments with street crossings in them were used for recreation as compared to path segments without street crossings. This may be explained by the fact that many of the street crossings occur where the lanes from the

cottages intersect with the road running along the perimeter of the campus.
Cottage/cluster residents need to cross over to the sidewalks along the perimeter road if they wish to take a longer route for recreation around the campus.
Path segments without steps were used more often for walking for recreation as compared to path segments with steps.
The presence of a destination along a path segment is not related to path segments being used for recreation. However, people walked for recreation along path segments with residential destinations. The likelihood of meeting other people and also the perception of being visible by the other people may be a factor related to these path segments being used for walking.

Local path characteristics that were not related to path use for recreation include the material of construction of the path segment (both indoors and outdoors), presence of path obstructions, path continuity and presence of amenities.

More path segments from which many different views can be seen were used for recreational walking as compared to path segments with few or no views. Further, more path segments with views to residences, tended (landscaped) nature or parking were used for recreational walking as compared to path segments that did not have these views.

Both global structural path characteristics are also related to path use for recreation. A higher percentage of central path segments were used for recreation as compared to less central path segments. Also, more path segments that lay on many routes on campus were used for walking for recreation as compared to path segments that lay on few routes.

Table 7.32: Results summary from analysis of local, relational and global path characteristics.

Path characteristics	Path use for getting to destinations	Path use for walking for recreation
Local Path characteristics		
Path Type: Does path type matter?	Yes. More outdoor path segments were used for walking to destinations as compared to indoor path segments. This is not true for all overall path use. Only significant for male residents, residents not using any assistive devices, residents aged 73 to 80 years, sufficiently active residents and cottage residents.	Yes: More outdoor path segments were used as compared to indoor path segments. True overall and for all resident categories except apartment residents.
Path length: Are longer path segments used for walking more than short path segments?	No difference between long and short path segments.	Yes. Longer path segments were used as compared to short path segments. This is true for overall path use and path use by resident categories.
Location of indoor path segments: Is the location of indoor path segments related to their use for walking?	No difference.	Yes. More path segments between resident apartments and path segments that were building connections are used as compared to other types of indoor path segments. True overall and for some resident categories.
Location of outdoor path segments: Is the location of outdoor path segments related to their use for walking?	Yes. More sidewalk segments were used as compared to all other types of outdoor path segments.	Yes. More sidewalk segments were used as compared to all other types of outdoor path segments.
Path material of outdoor path segments: Does path material matter?	No difference in path use between path segments constructed of different material	No difference.
Path material of indoor path segments: Does path material matter?	No difference	No difference.
Path slope: Does path gradient (slope) matter?	No difference between flat, moderate and steep slope path segments.	Yes. More moderately sloping and steep outdoor path segments were used as compared to flat outdoor path segments.
Path condition: Are more path segments in good condition used for walking?	Variable excluded – insufficient variation	

Table 7.33: Results summary from analysis of local, relational and global path characteristics.

Presence of street crossing: Are path segments with street crossings used less?	No difference	The opposite is found to be true. More path segments with street crossings in them were used as compared to path segments without street crossings. This was true overall and for some resident categories.
Presence of path obstruction: Are fewer path segments with obstructions used for walking?	No difference	No difference
Presence of steps: Are more path segments without steps used for walking?	No difference.	Yes. More path segments without steps were used for recreation as compared to path segments with steps. True overall and for some resident categories.
Path continuity: Are more direct path segments used for walking as compared to disjointed routes?	Yes. Disjointed path segments were not used at all by any of the residents for walking to destinations at PV.	No difference.
Amenities: Are more path segments with amenities (benches, trashcans, handrails, etc) used for walking?	No difference.	No difference..
Destinations: 1. Are more path segments with one or more destinations used for walking as compared to path segments without any destination? **2.** Is the presence of specific destinations related path use?	1. No 2. More path segments with *residences* along them were used for walking to destinations (true overall and for residents not using assistive devices and sufficiently active residents)	1. No 2. More path segments with residences along them were used for recreation. True for overall path use and for path use by most resident categories.

Table 7.34: Results summary from analysis of local, relational and global path characteristics.

Relational Path characteristics		
Views: 1. Are more path segments from which many different types of views are seen used for walking as compared to path segments with none or few views? 2. If a particular type of view (e.g. view of water) can be seen from a path does it were used more often?	1. No difference between path segments with different number of views 2. No particular type of view from a path segments was related to path use for walking to destinations.	1. Yes. 2. More path segments with views of residential areas, tended nature and parking were used for recreational walking.
Global Path Characteristics		
Average Distance: Are more shallow path segments used for walking as compared to deeper path segments?	Yes.	Yes.
Betweenness-centrality (choice): Are more path segments that lie on many routes used for walking as compared to path segments that lie on few routes?	Yes	Yes

The analysis of the data obtained from PV begins to suggest that a variety of factors may be related to path choice for walking (Table 7.43). Some of these factors are local – that is characteristics of the path itself, such as the length of the segments. Types of views and number of views from the path segment are relational path characteristics that may be related to walking. The centrality of a path segment within the network of path segments on campus is a global path characteristic that is related to instrumental and recreational walking.

However, the analysis above begins to suggest that some of these environmental characteristics may also be linked to each other. Many of the long path segments were also outdoor path segments segments (chi square = 20.5). Resident apartments and cottages/ cluster homes are for the most part located along long path segments (chi square = 21.7). There also were more views from longer path segments (chi square = 16.3). These interrelationships between variables can be better understood in the context of the overall routes that are selected for walking. Summarized below are the findings from the graphical analysis of highly used path segments and highly used routes taken together with the results of the statistical analysis presented earlier:

- Route choice for walking to destination is determined largely by the relative location of destinations and residences. At PV, more outdoor path segments were used for walking to destinations.
- Path segments that were used for walking to destinations were more central within the network of path segments and also lay on many routes on campus.
- Majority of the recreational walking trips were along outdoor routes.
- Outdoor routes used for recreation were looped rather than linear.
- The most commonly used route at PV was along the perimeter of the campus. This route was made of very long path segments, all of which lay on many routes (high choice) and are central within the campus network. Further, there are sidewalks all along this route. Also, this route has moderate to steep slopes.
- Other routes on campus (route 2, 3 and 4) that are infrequently used were usually combined with route 1 (perimeter route).
- Some possible reasons for infrequent use of these routes (route 2, 3 and 4) – low choice and less central segments and inconvenience in incorporating segments into a walking route.

- Indoor routes were also used for walking at PV, though less often than outdoor routes. Routes included segments between resident apartments on the first and second floor and the indoor connection between the RSC and HSC building.
- Majority of the residents walking the perimeter loop (route 1) only were classified as highly active. Residents walking only one of the other routes were insufficiently active or sufficiently active.
- Residents who walked a combination of routes were primarily highly active residents.

CHAPTER 8:

DISCUSSION AND CONCLUSION

The aim of this thesis was to identify the characteristics of path segments and routes that may be associated with where older residents choose to walk for recreation or for getting to destinations in retirement communities. The goal was to use the findings from this study to help formulate criteria and strategic choices that can be used to design retirement communities that support walking among elderly residents. In the absence of commonly accepted hypotheses about design factors that may be related to path choice for walking among the elderly, this thesis could not be structured to test ideas that guide current practice. This thesis asks instead what aspects of campus path design may be related to where older residents choose to walk.

The key questions that are addressed in this chapter are:

- What are the key path segment characteristics that are related to path use for walking to destinations or for recreation across the three communities?
- Can we explain why certain types of routes are popular in the three communities in terms of these key path segment characteristics?
- What does this tell us, if anything, in terms of designing retirement communities that support walking among older residents?

This chapter is organized into three main sections to address these questions. The first section looks at patterns of path segment use and route use across the three retirement communities and identifies key path characteristics that were related to where older residents walked in these communities. Highly used routes were compared across the three communities in terms of the structure of the route itself and in terms of the characteristics of the path segments that comprise the route. The second section assesses the findings from this study from the perspective of a designer or developer of retirement communities – what factors might they keep in mind while designing communities for active living. The final section identifies strengths and limitations of the study and identifies future research directions based on the findings of this dissertation.

8.1 Comparison of case study findings

Here the findings are compared across the three communities for each type of walking behavior – walking for recreation and walking to get to destinations. Table 1 and Table 2 summarize the path characteristics across the three communities that are related to path use for walking. Variables that were significantly related to path use in all three communities are indicated in green. Variables that were significantly related to path use in only one or two of the three communities are indicated in yellow. Variables that are not highlighted were not related to path use in any of the three communities.

8.1.1 Path use for walking to destinations

Presented below is a tabular summary (Table 1) of the relationship between path segment characteristics and path segment use for walking to destinations in the three retirement communities.

Table 8.1: Path characteristics that are related to path use for walking to destinations in the three communities

Path Characteristics	**PS retirement community**	**LV retirement community**	**PV retirement community**
Local path characteristics			
Path Type: Are more internal path segments used as compared to external path segments?	**Yes**	**Yes**	**Opposite is true.** Outdoor path segments are used more.
Path length: Are longer path segments used for walking more than shorter path segments?	No difference	No difference	No difference
Location of indoor path segments: Is the location of indoor path segments related to their use for walking?	**Yes.** Path segments between resident apartments used more than others. Opposite for cottage residents.	No	No
Location of outdoor path segments: Is the location of outdoor path segments related to their use for walking?	No	**Yes.** Fewer paths/trails through nature were used as compared to other outdoor path segments	**Yes.** More sidewalk segments were used as compared to other outdoor path segments
Path material of outdoor path segments: Does path material matter?	No	No	No
Path material of indoor path segments: Does path material matter?	No	No	No
Path slope (gradient): Are paths that are flat used differently from moderately sloping or steep path segments?	No difference	No difference	No difference
Path condition: Are more segments in good condition used for walking?	Variable excluded – insufficient variation		

Table 8.2: Path characteristics that are related to path use for walking to destinations in the three communities

Presence of street crossing: Are path segments with street crossings used less?	No difference	No difference	No difference
Presence of path obstruction: Are fewer path segments with obstructions used for walking?	No difference	No difference	No difference
Presence of steps: Are more path segments without steps used for walking?	**Yes.** Relationship is true overall and for three resident categories only.	No difference	No difference.
Path continuity: Are more direct path segments used for walking as compared to disjointed routes?	No difference.	Variable excluded – insufficient variation	**Yes**
Amenities: Are more path segments with amenities (benches, trashcans, handrails, etc) used for walking?	No difference	**Yes**	No difference
Destinations: 1. **Presence of destinations:** Are more path segments with one or more destinations used for walking as compared to path segments without any destination?	**Yes**	No	No
2. Type of destination: Is the presence of a specific destination along a path segment related to use?	**Yes.** More path segments with *activity related areas* along them were used.	**Yes.** More path segments with *activity related areas* and *administrative areas* along them were used.	**Yes.** More path segments with *residences* along them were used for – true overall and for 2 resident categories only.

Table 8.3: Path characteristics that are related to path use for walking to destinations in the three communities

Relational Path Characteristics			
Views: 1. **Number of views:** Are path segments from which many different types of views are seen used for walking as compared to path segments with none or few views?	No difference	No difference	No difference
Views: **2. Type of view:** Are more path segments with particular types of views used for walking?	**Yes.** More path segments with views of water (lake), public spaces or art were used. Fewer path segments with views of residential areas or tended nature were used	**Yes.** More path segments with views of public spaces or art were used.	No.
Global Path Characteristics			
Average Distance: Are more shallow path segments used for walking as compared to deeper path segments?	**Yes**	No difference	**Yes**
Choice: Are path segments that lie on many routes on campus used for walking more than path segments that lie on few routes on campus?	**Yes**	**Yes**	**Yes**

Variables related to path use in all three case studies

We find that ***path type*** – whether a path segment was located indoor or outdoor– seemed to matter for walking to destinations in all three communities. In both PS and LV, a higher percentage of indoor path segments were used for walking to destinations on campus as compared to outdoor path segments. On the other hand, a higher percentage of outdoor path segments were used for walking to destinations on PV. These findings can be explained by the location of the destinations within the campus. In PS and LV, the two key destinations that residents walked to were at different physical locations, but were still connected through a system of indoor corridors connecting clubhouse and resident buildings. At PV, on the other hand, the two destinations were in two different buildings that were not physically connected. The Village Center, a key destination for social gatherings and wellness-related activities, was physically separate from any residential buildings, while the dining room (the second key destination) was located in the resident apartment building. Cottage residents walked along outdoor path segments to both destinations and all residents who visited the Village Center walked along outdoor routes to reach the Village Center. Thus, the location of residents and the location of resident apartments relative to the destinations explain a lot about path choice for walking to destinations.

The presence of a ***specific type of destination*** along a path segment was also related to path use for walking to destinations at all three communities. In PS, more path segments with *activity related areas* (exercise room, club room, etc.) were used for walking to destinations. In LV, more path segments with *activity related areas and administrative areas* along them were used for walking to destinations. In PV, more path segments with *residences* along them were used for walking to destinations. Again, the findings in each community can be explained in terms of the location of destinations that residents walked to on campus (at PS and LV the key destinations were clustered near activity related and administrative areas).

The other factor that was related to path use for recreation in all three communities was the structural variable **–** ***choice***. The finding, consistent across the three communities, was that path segments that lay on many routes on campus (high choice) were used for walking to destinations as compared to path segments that lay on no or few routes connecting other segments. This is an important finding that suggests that the structure of the layout of path segments on campus may influence choice of path segments for walking to destinations. Indoor path segments at PS and LV on the main clubhouse floors connecting residential buildings to the clubhouse were all high choice segments.

<u>Variables related to path use in one or two case studies</u>

Another global structural path characteristic that was related to path use for walking to destinations is the ***depth*** of a segment from all other segments on campus. At PS and PV - more path segments that were central to all other path segments on campus were used for walking to destinations as compared to path segments that were less central within the campus network. The relationship between depth and path use for walking to destinations was not significant at LV. It is not clear why this is so, especially given that choice was related to path use for walking to destinations and choice and depth and also related to each other.

The other variable that seems to matter in two but not all three of the communities is the ***type of view*** that can be seen along the path segment. Thus, at PS and LV, more path segments with *views of art* and *views of public spaces* were used for walking to destinations. This was not significant at PV. In PS and LV, the two key destinations were located in the clubhouse building. The clubhouse building is the common public space for the community and is well decorated with attractive furniture, finishes and artwork which may explain why these variables were significant. At PV on the other hand, the routes leading to the key destinations on campus were not very well articulated with artwork or finishes.

The ***location of outdoor path segments*** is related to path use at LV and PV. We find that at LV fewer path/trails through nature were used for walking to destinations as compared to other path segments. At LV, this means the landscaped trails behind the East and West Village buildings were used less for walking to destinations as compared to other outdoor path segments (road segments, sidewalk segments). One reason why these path segments may be used less by residents is because a key card is needed to access the building from this side – a possible deterrent to residents coming in for a meal or for activities.
Other variables that are related to path use in one of the communities, but not all include – the presence of steps in the path segment, path continuity, presence of amenities and the presence of one or more destinations along the path segment.

Variables that were not related to path use

The variables that were not related to path use for walking to destinations in all three communities were – path length, path material (of indoor and outdoor path segments), path slope, presence of a street crossing and presence of a path obstruction in the segment. These variables are all local path characteristics of the segment. Path segments from which many different types of views can be seen (a relational path characteristic) were used no differently from path segments with few views in all three communities.

Finding that certain variables are consistently related to path use across the three different case studies increases our confidence that these variables are related to path use for walking in retirement communities. To summarize the above discussion, key variables that were related to path use for walking to destinations in all three communities:

- Path type – indoor or outdoor
- Presence of specific destinations along a path segment
- Choice

The findings from this thesis suggest that path segments chosen for walking to destinations largely depend on the location of the individual's residence and the relative location of the destinations.

There is also some indication that a resident's decision to walk to a destination (as opposed to driving to it) may also be shaped by the purpose of the trip (e.g. dining, exercise class), and this may be a particularly relevant consideration when residential areas were not physically connected to destinations through covered connections. For example, dining is a social occasion and many residents, especially female residents, may 'dress up' for meals. Residents who live in apartments which are connected though protected indoor corridors to the dining area can easily walk to dining without much discomfort and without disturbing their appearance. Residents who live in cottages would need to walk outdoors across campus in shoes and attire that may not be appropriate for outdoor walking. On the other hand, preserving his/her appearance may not be a major consideration for a cottage resident who needed to visit the exercise room at the clubhouse. While the data from this study does not strongly support this pattern of behavior, informal discussions with residents and staff suggest that comfort (walking surface, protection from elements) may be an important consideration for residents while deciding to walk to a destination rather than drive to it.

Walking to destinations is an important physical activity for residents in retirement communities. For example, some residents at LV walked almost 0.5 mile during a trip to the dining room and back. However, apartment residents at PV did not have to walk very long to reach the dining room as the dining room was located on a lower floor in the same building. Clearly, the residents at LV are more likely to walk more on a daily basis even if they did not walk for recreation on campus. Thus, one might be tempted to say that creating long corridors between resident living areas and destinations would be an effective strategy for promoting walking on a daily basis. However, an undesirable side-effect of this might be that many residents (especially those with health problems or those who do not like walking) might perceive this to be an inconvenience or a very difficult walk and might begin using amigos (carts) for reaching the dining room and back (as is the case at LV). For these residents, daily instrumental walking may actually end up being reduced dramatically. It is important to balance the needs (perceived and real) of this population with the objective of promoting daily physical activity.

8.1.2 Path use for recreational walking

Presented below is a tabular summary of the relationship between path characteristics and path use for walking for recreation at the three retirement communties.

Table 8.4: Path characteristics that are related to path use for walking for recreation at the three communities

Path Characteristics	PS retirement community	LV retirement community	PV retirement community
Local path characteristics			
Path Type: Are more outdoor path segments used as compared to indoor path segments?	Yes. Opposite is true for insufficiently active residents.	Yes.	Yes.
Path length: Are longer path segments used for walking more than shorter path segments?	Yes.	Yes.	Yes.
Location of indoor path segments: Is the location of indoor path segments related to their use for walking?	Yes. More segments between resident apartments used for walking.	Yes. More segments between resident apartments used for walking.	Yes. More segments between resident apartments and indoor connections between building used for walking.
Location of outdoor path segments: Is the location of outdoor path segments related to their use for walking?	Yes. More sidewalk segments were used for walking.	Yes. Fewer paths/trails through nature were used for walking.	Yes. More sidewalk segments were used for walking.

Table 8.5: Path characteristics that are related to path use for walking for recreation at the three communities

Path material of outdoor path segments: Does path material matter?	No	Yes. More path segments made of bitumen were used for walking.	No.
Path material of indoor path segments: Does path material matter?	No	Variable excluded – insufficient variation	No
Path slope (gradient): Are paths that are flat used differently from moderately sloping or steep path segments?	Yes. More moderately sloping and steep sloping path segments were used for walking	No difference	Yes. More moderately sloping and steep sloping path segments were used for walking.
Path condition: Are more segments in good condition used for walking?	Variable excluded – insufficient variation		
Presence of street crossing: Are path segments with street crossings used less?	No difference	No difference	Opposite is true. More path segments *with street crossing* were used for recreational walking.
Presence of path obstruction: Are fewer path segments with obstructions used for walking?	No difference	No difference	No difference
Presence of steps: Are more path segments without steps used for walking?	Yes	Yes	Yes
Path continuity: Are more direct path segments used for walking as compared to disjointed routes?	Yes.	Variable excluded – insufficient variation	No difference.
Amenities: Are more path segments with amenities (benches, trashcans, handrails, etc) used for walking?	Opposite is true: more path segments *without* amenities were used for recreation.	Opposite is true: more path segments *without* amenities were used for recreation.	No difference.

Table 8.6: Path characteristics that are related to path use for walking for recreation at the three communities

Destinations: 3. **Presence of destinations:** Are more path segments with one or more destinations used for walking as compared to path segments without any destination?	Yes.	No difference.	No difference
Destination: **4. Type of destination**: Is the presence of a specific destination along a path segment related to use?	Yes. More path segments with *residential areas* and *parking areas* along them were used for walking. Residents using assistive devices used path segments with *natural destinations* along them.	No.	Yes. More path segments with *residential areas* along them were used for walking.
Relational Path Characteristics			
Views: 3. **Number of views:** Are path segments from which many different types of views are seen used for walking as compared to path segments with none or few views?	Yes. Marginally significant overall and for three resident categories.	No	Yes
Views: **4. Type of view:** Are more path segments with particular types of views used for walking?	No. Type of view did not matter.	Yes. More path segments with views of residential areas, tended nature and destinations (not on path) were used.	Yes. More path segments with views of residential areas, tended nature and parking were used.
Global Path Characteristics			
Average Distance: Are more shallow path segments used for walking as compared to deeper path segments?	Yes	No	Yes

Table 8.7: Path characteristics that are related to path use for walking for recreation at the three communities

Choice: Are path segments that lie on many routes on campus used for walking more than path segments that lie on few routes on campus?	Yes	Yes	Yes

<u>Path characteristics related to path use in all three communities</u>

Path type was related to path use for recreational walking – a higher percentage of *outdoor path segments* were used for walking for recreation as compared to indoor path segments. This was true for all three communities. However, when we look at the campus plans with the 20 paths that were used most by residents (Fig 6.3, Fig 7.3 and Fig 8.4) for walking for recreation we see that in addition to outdoor path segments, indoor path segments were also among the highly used path segments for recreational walking. In all three communties, these highly used indoor path segments were primarily corridors between resident apartment on resident floors that connected with the public spaces (such as the clubhouse) and path segments through the clubhouse.

The fact that indoor path segments ***between resident apartments*** were used for recreational walking is also shown statistically. In all three communities, indoor path segments between resident apartments were used more for recreational walking than other types of indoor path segments. Only anecdotal evidence was available to date that elderly residents walk corridors for exercise. This study shows that corridor walking may be an important exercise for many elderly residents in retirement communities, especially in inclement weather. The significance of corridor walking has been noted by the developer of PS who plans to include an indoor glass covered loop around their new fitness center so that residents who walked the resident corridors for exercise (sometimes a disturbance for other residents) may instead use the loop for walking.

The ***length*** of path segments was strongly related to path use for recreation in all three communities. This was true for overall path use and path use by all categories of residents. The findings show that longer path segments were used for recreational walking as compared to short path segments. This is an interesting finding which might imply that residents prefer longer uninterrupted stretches while walking for recreation. And this may be true for both indoor and outdoor walking since we see that the long resident corridors were preferred to the shorter path segments through public areas.

Among outdoor path segments, more ***sidewalk segments*** were used for recreation as compared to other types of outdoor path segments at PS and PV. At LV, fewer paths/trails through nature were used for recreation as compared to all other outdoor path segments. It is possible again, that the need to use a key card to enter buildings from the side of campus with the trails may be the reason why these attractive trails were used less than other outdoor path segments.

In all three communities, more path segments ***without steps*** were used for recreation as compared to path segments with steps. This seems to suggest that not many elderly residents chose stairs/steps actively as part of their exercise/recreation routine. Interestingly enough, in all three communities there was no relationship between the presence of steps in the segment and path use for recreation by residents using assistive devices. We would expect that residents using assistive devices would avoid steps. An insignificant finding indicates that there was no difference in their use of segments with and without steps (which may mean avoidance of both or use of both, the former being the case).

The other variable that is related to path use for recreation in all three communities is ***choice***. That is, in all three communities path segments that lay on many routes on campus were used for recreational walking as compared to path segments that lay on few routes. Intituitively this makes sense as it suggests that these segments are more easily incorporated into a recreational walking route.

<u>Path characteristics related to path use for recreation in one or two of the communities</u>

Depth of the segment within the layout – that is, how far it is from all other path segments on campus matters. More path segments that are central within the campus network were used for recreational walking as compared to path segments that were less central within the system (PS and PV).

If path segments had certain ***destinations*** along them – they were more likely to be used for recreational walking. Specifically, the presence of residences along a path was related to path use for recreation at PS and PV. Also, at PS residents using assistive devices tended to choose paths with natural destinations along them for recreational walking. The presence of a specific destination was not related to path use for recreation at LV.

Path segments that had many ***different types of views*** from along them were more likely to be used for recreation as compared to path segments with few or no views. This variable was significant at PS and PV, but not at LV. Also, more path segments with views of residences and landscaped nature were used for recreational walking (LV and PV).

An unexpected finding is that more path segments with no amenities were used as compared to path segments with amenities. This was true at PS and LV. This finding can possibly be explained by the fact that in these communities, most path segments with no amenities were the outdoor path segments. Also, more outdoor path segments were used for recreation. Thus, this finding may reflect the location of the path segments and be less about the presence or absence of amenities.

Other factors that were related to path use for recreation at only one of the communities include –

- Path material of outdoor path segments – more bitumen paths were used at LV
- Slope – at PV more moderately sloping or steep path segments were used
- Presence of a street crossing – at PV more path segments with street crossing were used
- Path continuity – more direct path segments were used at PS
- Presence of destinations – at PS more path segments with destinations were used

Path characteristics that were not related to path use for recreational walking in any of the three communities are path material of indoor path segments and presence of a path obstruction in the path.

Key variables that were related to path use for walking for recreation in all three communities:

- Path type – indoor or outdoor
- Length
- Location of indoor segments
- Location of outdoor segments
- Presence/absence of steps in segment
- Choice

The path segments and routes that were highly used for recreation on the three campuses were analyzed in this thesis. This analysis taken together with the findings from the statistical analysis of path segments suggests some interesting relationship between path design and use. In all three communities we found that both indoor path segments and outdoor path segments were highly used. Further, the indoor and outdoor routes that were chosen for walking in the three communities have their own peculiar characteristics that merit discussion. Here, the characteristics of indoor and outdoor routes are discussed seperately and the factors that seem to be common to both types of recreational walking (indoor and outdoor) are discussed.

<u>Indoor routes</u>

Indoor routes are important for recreational walking

This is the first study to document the importance of indoor recreational walking among older residents in retirement communities. At all three communities residents walked indoors for recreation. At LV, a higher proportion of the most highly used path segments were located indoors. At PS and PV more of the outdoor path segments were highly used. Protection from the weather, easy walking surface and exercise/distance walked were given as the reasons for choosing indoor routes. Residents who walked extensively indoors (all floors of all buildings) tended to give exercise as their reason for walking and were aware of the distance they walked.

Why certain types of indoor routes are preferred

In all three communities we see a strong preference for walking along the corridors between resident apartment than in other indoor areas (such as public areas). While residents passed through public spaces during their walk, there were no instances where the resident walked exclusively in public spaces (such as the clubhouse) for recreation. Resident corridors may be preferred for walking because they provide long uninterrupted stretches for walking (length of segments was related to path use for recreation) while public areas tend to be fragmented into smaller segments and required more turns and twists around furniture and people. Further, corridors between resident apartment on floors with indoor connections to other buildings were used more than path segments on other resident floors in all three communities. The path segments on such floors were more central segments and high choice segments in all three communities.

Residents chose indoor routes with different levels of difficulty

Residents chose routes of differing lengths. Some residents walked up and down the corridors of a single floor while other residents walked all the residents floors in a single building and others walked all floors of all buildings in the community. This was more evident at PS and LV rather than at PV where there are fewer options for choosing between indoor routes. At both PS and LV, the residents who chose the longest indoor routes (all floors, all buildings) were younger (less than 80 years), did not have any health problems and were either sufficiently active or highly active. Of the residents who chose the shorter indoor routes, many were older (81 years or above), some had health problems that affected walking and some were insufficiently active. This suggests that residents of different abilities may choose indoor recreational routes based on the level of difficulty or challenge afforded by the route (in this case determined by overall length). Providing options allows residents to decide what suits them best and gives them the choice to ‘upgrade’ to a more challenging route when they feel more confident. This option is also available to PV residents though to a more limited extent.

<u>Outdoor routes</u>

Residents preferred looped outdoor routes for recreational walking

Around 75% of the respondents in each community walked outdoors for recreation. Of the residents who walked outdoors for recreation, a majority chose to walk along looped outdoor routes. These are routes that started and ended at the same point without repeating any part of the route. At PS, only two residents chose linear routes (from A to B and back along the same route), four at LV and five at PV.

If we compare the routes across the three communities, we see that the routes fall into four main categories:

1. Contained loops: These are small, contained routes made of long, smooth segments. The loop around the lake at PS and inside the parking lots at LV are examples of this type of route. The small loop by the cottages (route 3) at PV is also an example of this type of loop. Frequently cited reasons for using this route included ease, safety, attractive views.
2. Looped route through nature: Looped routes made of some long and many shorter path segments. These routes cut through the campus, along landscaped nature trails or paths. The contours of this type of route are not smooth. Routes 3 and 5 at PS (Figure), route 2 and 3 at LV and route 4 at PV are examples of this type of route. Frequently cited reasons for using this type of route included opportunity to see variations in campus scenery and exercise.
3. Perimeter routes: Long looped routes made of long, smooth (few twists and turns) path segments that follow the perimeter of the campus. Most of the path segments making up this type of route are road segments or sidewalk segments. Route 2 at PS, route 1 at LV and route 1 at PV) are examples of this type of looped walking route. Frequently cited reasons for using this type of route included exercise/distance covered and views.

4. Looped route through residences: These are routes passing between the cottage/cluster homes on campus. Strictly speaking, this is not a looped route since at PV and LV residents walked back and forth along the streets between the cottages. However, no resident in any of the three communities walked between the cottages exclusively during their walk. Thus, it was not classified as a linear route. In all three communities, it was combined with other routes on campus.

There is almost a hierarchy of looped routes with increasing levels of challenge associated, when we move from the first to the third category. While routes were not assessed independently in this study, these routes can be so defined in terms of the characteristics of the path segments that they are comprised of.

The contained loops identified in this study were considered 'low challenge' because they were short in total length, made of flat segments, with access to amenities (benches) and with many different types of views along them. Further, these routes were located within easy access and view of buildings on campus. The perimeter loops were the most challenging because they were long (total distance and long individual segments) with steep and moderately sloping path segments that had few amenities such as benches along them. The routes that cut through campus vary between moderately to highly challenging –there may be some steep or moderately sloping segments and the route can vary in length depending of the exact route taken. This type of route was characterized by frequent changes in direction and exposure to many different types of views along the route.

Figure 8.1: Recreational routes on the PS campus

Figure 8.2: Recreational walking routes on the LV campus

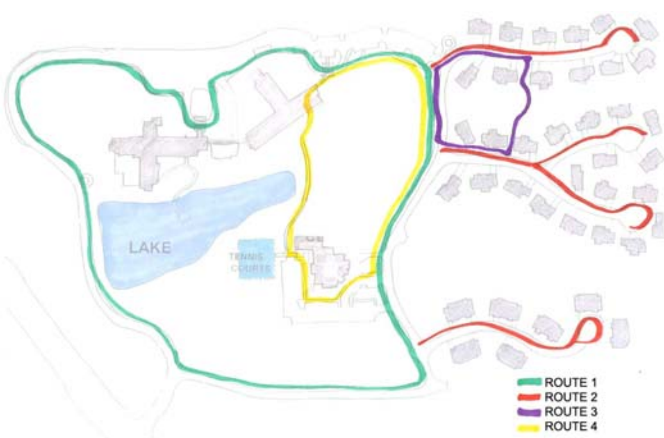


Figure 8.3: Recreational walking routes on the PV campus

Characteristics of routes that were used most and least

The route that was used most for recreational walking (alone and combined with other routes) in each community was:

- the route around the lake at PS (route 1 in Figure 8.1)
- the perimeter route at LV and the parking lot route (route 1 in Figure8.2)
- the perimeter route at PV (route 1 Figure 8.3)

At LV, no single route tends to be used a lot for walking without being combined with other routes. However, we find that both the campus perimeter route and the route around the parking lot are used a lot in combination with other routes. The four routes are different in terms of overall length and challenge with the lake route at PS and the parking lot route at LV being similar and the perimeter routes at LV and PV being similar.

Inspite of these differences there were some commonalities between the 4 commonly used routes:

- Route was made up of relatively long path segments.
- Route had smooth contours with few and gradual changes in directions along the route
- The segments comprising the route were high choice – located on many routes on campus
- Many different types of views (i.e. landscaped nature views, untended nature views, residential views, views of other destinations not on path) could be seen along this route.

Thus, the characteristics of path segments that are related to path use for recreation across the three communities (length, choice, number of views) also explain why certain routes are most popular across these communities.

The route that was used least for recreational walking (not combined with other routes) in each community was:

- Route 5 at PS (Figure 1)
- Route 2 at LV (Figure 2)
- Route 4 at PV (Figure 3)

These three routes are all looped routes through landscaped gardens/parks. The segments along these routes were all accessible within the network of paths (more central) and were also high choice (lie on many routes on campus). These routes all include beatifully landscaped nature trails with attractive views of the campus. Why then are these routes not chosen often for recreational walking?

One possible reason for low route use could include the presence of steps in segments along the route. The route at PS involved walking down (or up depending on the direction of travel) the steps in the landscaped courtyard and then again taking the steps up in the clubhouse for completing the route. Taking the trail behind the RSC building for recreation also involved changes in level through buildings (the RSC and the Village Center). This added an extra level of complexity to the route and introduced many changes in direction in the path of travel.

Another possible reason why these routes were not as popular for recreation as the other routes may be because the routes were broken up into many smaller segments which effectively slowed down the individual. Such routes may be more suitable for strolling and stopping and looking than for goal-oriented (such as for exercise) recreation. At LV, the landscaped route behind the West Village was broken up into smaller segments. Another reason why this route may not be used as often as the others is that it requires entry and exit from the side of campus where key cards were required to enter the building. Thus, only those residents who remembered to carry their key card with them were likely to use this route.

Residents may choose different types of outdoor routes based on their abilities

As in the case of the indoor routes, we see that residents of different abilities tended to choose different types of routes for recreational walking. Of the residents who chose to walk only around the lake at PS or only around the parking lot at LV many tended to be older, some had health problems or used an assistive device and some were classified as insufficiently active or sufficiently active. Similarly at PV, the small looped trail by the creek and the trail between the RSC and the Village center were used by insufficiently active and sufficiently active residents. At LV and PV, the residents who used the shorter linear routes were older, some with health problems and were insufficiently or sufficiently active.

The residents who used the most challenging routes such as the perimeter route at LV or PS were almost all younger, without any health problems and tended to be classified as highly active. Also, most of the residents who used a combination of routes in any of three communities were healthy and were classified as sufficiently active or highly active.

Then there are other routes (such as route 3 and 5 at PS; route 2 and 3 at LV) that vary between moderately challenging to highly challenging depending on the exact route taken. There is no clear pattern evident about the type of residents who used these routes.

Key characteristics of recreational walking at the three communities

The routes (indoor and outdoor) that were used most for recreational walking at all three communities were made of long path segments with few turns or changes in direction. This 'track' like character of these routes made them particularly amenable for walking for exercise. These routes if they were small (e.g. lake at PS, resident corridors) were often repeated - like walking around an exercise track. This is also true for indoor walking. Residents tended to walk up and down resident corridors several times or walk corridors on all resident floors in all buildings. Corridors in public spaces that tended to be shorter and more fragmented were not used as much for recreational walking. Clearly, the straight track-like nature of the resident corridors is more appropriate for goal-driven (exercise) walking.

The path segments along these highly used routes tended to be very central within the network of path segments on campus (shallow) and also tended to fall on many routes on campus – which makes it more likely for these segments to be incorporated within a walking route. In addition, these routes especially the outdoor routes, tended to have many different types of views from along them. Another key characteristic that appears to be important for outdoor walking routes is that they tended not to have steps or changes in level in them.

Routes on campus that resident chose for 'fun' or leisure may have slightly different characteristics though such routes were not used much in the three communities studied. These are routes that cut through landscaped parts of campus. These routes were made of many smaller segments and in some cases involved the resident entering and exiting different buildings. These routes tended to be more arbitrary – as there were many smaller segments along the route and the resident can easily change direction as he/she walks. They routes are very attractive with beautiful views of campus. These routes seem more appropriate for strolling, stopping and looking and are more likely to be chosen by residents who are walking for fun. These routes were also made of segments that were accessible from all parts of campus.

Routes that were only used in combination with other routes tended to be made up of segments that were less accessible within the network of path segments and were located on few routes on campus. These routes were more likely to be included within a longer walk on campus than be chosen exclusively for walking.

In all three communities studied, residents had options of walking routes to choose among and this is true for both indoor and outdoor walking routes. These routes differed in terms of how demanding they were. What is interesting to note is that different types of residents chose different types of routes. Thus, we are more likely to find residents in retirement communities with health problems or those using assistive devices or those who are classified as insufficiently active using only the least demanding route. On the other hand, routes that were highly demanding or routes that were combined with one or more routes were more likely to be used by highly active and healthy residents. Then there are those routes that are moderately challenging and these may be used by residents who may have some problems or are not very active, but are ready to take on more challenge.

This begins to suggest that as residents are ready to become more active or take on more challenge in their daily physical activity routine, they may start using more demanding walking routes. It is then critical that there are more demanding options available for residents who are ready for it. This is in accordance with the environmental press-competence theory. According to this theory, individuals adapt and respond well to environmental demands that they perceive as being congruent with their competence level. If the demand is slightly higher or lower, they will still respond well. However, if the demand was very high (for example only demanding walking routes were available for walking) then there would be maladaptive behavior (e.g. stop walking outdoors) among low competence individuals. Alternatively, a high competence individual (e.g. healthy and highly active) exposed to a low demand environment would also respond poorly (may be bored and lose interest). Thus, the challenge lies in providing a range of attractive options to choose from. Also, options need not be limited to the retirement community.

Highly active residents at the three communities also utilized resources at nearby facilities to be physically active. Some residents at PS play golf and walk at Stone Mountain Park and residents at LV walk down to Lake Lanier from the campus and back. The PV campus is not physically connected to a public trail or facility. However, some residents drive down to a nearly mall or the Silver Comet Trail and walk there for exercise.

The discussion above clearly shows the importance of the ecological framework for assessing physical activity behavior. The findings from this study can be best understood and interpreted only when we consider how environmental factors (path characteristics) are related to path use and route use for recreation *by different types of residents* on campus. Had we assumed a homogenous group of individuals, it would be difficult to explain why different routes that were so different in terms of challenge and character were almost equally important for walking and why.

8.2 Designing retirement communities for active living

The analysis of path use and route use discussed earlier begins to explain why some routes are more amenable to walking than others and by whom. The research findings tell us which path segments and the routes they are part of are used for walking in retirement communities. The aim of this thesis is not to provide guidelines for designing retirement campuses for active living. Rather, the goal is to provide the context within which developers and designers of retirement can make strategic choices for designing activity friendly retirement communities. While this study looks at path use for recreation and for getting to destinations, the key findings of interest are related to recreational walking. Thus, there is a stronger focus on findings related to recreational walking. While the findings from this study do not automatically suggest design strategies, there are clearly some implications for designers. Some of the findings from this dissertation that designers may want to consider while designing retirement community for active living are discussed below.

Finding: *Race tracks or loops are preferred for exercise*

Recreational routes used for goal oriented exercise were race track like loops with long path segments and gradual changes in directions. These looped routes generally did not involve transitions between inside and outside for completing the route. Most campuses had at least one long outdoor ‘track’ - usually along the perimeter of the campus and one shorter track. Shorter tracks that were popular tended to be close to main building entries with views to campus buildings. Shorter tracks tended to be less demanding in terms of terrain (mostly flat path segments). Longer tracks were more challenging and had many different kinds of views. The ‘tracks’ that were used most in the three communities studied were all made up of path segments that lay on many routes on campus (high choice path segments). Residents who used these routes usually stated exercise as the reason for selecting the route and in many cases were aware of the distance walked.

Design implications –

- Consider incorporating accessible loops (made up of shallow and high choice path segments) of different lengths into the network of paths.
- Smaller loops may be located close to buildings within easy view of building entries and may be less demanding in terms of path gradient.
- Consider placing markers at key decision points along longer routes to mark distance walked.

Finding: *Looped routes through nature may be preferred for leisure walking*

Residents who chose routes that included landscaped trails tended to mention views and variations in campus scenery as the reason for choosing the route. These routes tend not be very well defined and often included many small segments allowing for frequent changes in direction. They often involved changes in level though buildings and outdoors and tended to more complex. These routes were not used very often at these communities possibly because of difficulty associated with transitioning in and out of buildings. Also, these routes may not be most appropriate for goal oriented recreational walking. However, the importance of such routes and path segments for leisure walking should be considered.

Design implications:

- Consider integrating nature trails with other highly accessible outdoor routes

- Consider the transition between nature trails and buildings and identify any barriers to easy transition

Findings: *Residents of different abilities choose routes offering different levels of challenge*

Residents choose recreational walking routes that they perceive as being within their capability. The most active and healthy residents chose the most challenging routes on campus or combined different routes to complete their walk. Since this was not a longitudinal study it was not possible to assess whether the residents transitioned to routes of gradually increasing difficulty levels as their health status improved. However, the fact that residents of different abilities used different types of routes suggests that having a hierarchy of routes (in terms of challenge) facilitates this transition. These communities were also located close to other public recreational facilities that were utilized by residents, providing another level of challenge to residents who were ready for it.

Design Implications:

- Consider carefully whether routes with different levels of challenge have been incorporated on campus
- Consider access to other public physical activity resources while identifying a site for the community.

Finding: *Corridors between resident apartments are highly used for recreation*

The importance of indoor walking, primarily between resident apartments has been underscored in this thesis. Two of the communities had many residential building all of which were connected to a main clubhouse building at different floors. This produced an extensive system of indoor path segments in these two communities.

As compared to these communities, PV had limited options for walking indoors. More residents choose to walk indoors in the communities with more indoor path segments (consequently more route options). Having more route options also allowed residents to structure their recreational route according to their ability.

Design Implications:

- Consider designing resident apartment corridors to facilitate more walking – this may include increasing corridor widths, increasing lighting level, punctuating the corridor with seating areas and views to the outdoors.
- Consider connecting different buildings on campus to facilitate walking to destinations as well as to create a network of paths that can be utilized for recreational walking. This may be especially important in regions with inclement weather.
- Consider placing distance markers at key decision points so residents can keep track of the distance they walked

Finding: *Where residents live relative to where destinations are located determine the route they select for walking to destinations*.

Indoor routes were used extensively in the communities where residential buildings were connected to the key activity-related building through indoor connections. The presence of a covered connections facilitates walking to destinations. In the absence of a covered walking path to destinations, residents may choose not to visit the destinations or may choose to drive there, especially if the distances were large and the route challenging (uphills). For example, the lack of a covered connection between the residential building and the Village Center at PV was mentioned as an obstacle to greater use of the programs offered there. If the distance between residents' homes and destinations is perceived as being too large residents may choose to drive a car to the destination or may start using a golf cart.

Design Implications:

- Consider the distance between resident homes and key destinations such as dining while laying out campus.
- Consider providing indoor connections to key destinations where possible.

8.3 Strengths and Limitations

This is the first study of its kind exploring the relationship between path characteristics and path use for walking in a campus type setting such as a retirement community. Further, this study breaks new ground by exploring these relationships within the context of older adults who are by no means a homogenous group. One of the key strengths of this thesis lies in providing a precise and quantitative description of the relationship between path segment characteristics and path segment use for walking and then being able to use these findings to explain route choice for walking by different types of residents. Also, using space syntax methods provides an objective way to analyze path segment networks on campus to understand why certain path segments are used often and why that may explain higher use of some routes over others. Further, by adopting an ecological framework for assessing these relationships, this study is able to explore these relationships within the unique context of the retirement community and the individuals who live there.

By identifying patterns that repeat across the three communities, the findings from this study are further strengthened. The findings from this study can be generalized to other campus type CCRCs. As shown in chapter 3, the facilities selected for case study were fairly similar to the nationwide sample of CCRCs. However, PS and LV are newer communities with a larger number of residents and PV is older with fewer residents. The fact that the findings were repeated across all three communities gives them wider applicability. While this study has been conducted among independent living residents, it is plausible that the findings may also be applicable to other types of senior housing facilities. Especially, the importance of indoor walking routes, structural path characteristics and looped walking routes may be important for walking even among older adults in assisted living facilities and other types of residential facilities. Finally, some aspects of path use for walking such as length, choice, presence of steps and barriers to transition that were related to route choice for exercise walking among active older adults may also be important factors to consider while designing other types of campus settings such as university or office campuses where people might walk for exercise. Thus, this study potentially has implications for path design for walking in different types of settings.

However, that said, one of the limitations of this study is the small number of cases studied. If the study could be conducted in a larger number of settings and the patterns repeated across these settings, we would be even more confident of our findings. Another limitation of this study is the response rate–11% of residents at PS and LV and 28% of residents at PV volunteered for the study. Also, it was difficult to obtain facility wide demographic data in all three communities to ascertain if the sample was truly representative.

8.4 Future Research Directions

An obvious first step towards strengthening the findings from this study would be to apply the methods used in this study to other campus type retirement communities to see if similar relationships between path characteristics and path use for walking can be observed. The findings would also be supported by recruiting more residents at each case study site.

It would also be interesting to see whether similar patterns of walking and route choice are observed among older adults living in traditional neighborhoods that are structurally different from the self-contained campus type retirement communities.

A longitudinal study could assess if residents gradually explore more demanding routes if they participate in a regular walking routine aimed at increasing their strength and confidence in walking. It would be interesting to see if residents gradually increase their physical activity levels by transitioning from one type of walking route to another more demanding one. Does the presence of walking routes of different difficulty levels on campus facilitate this transition?

Given the nature of the sample (high proportion of highly active residents participated) this study focused on where active older adults walked. Fewer residents in the sample were non walkers or inactive. A future study could focus on recruiting more different types of residents so that walking patterns and barriers and facilitators to walking among these different individuals can be determined.

What happens in retirement communities with few options for walking such as high rise retirement communities on small sites? Do residents participate in more structured exercise classes to compensate for fewer walking opportunities? Or does this mean that residents are just less physically active? It would be interesting to compare campus type retirement communities with high-rise retirement communities which had similar resident population to assess overall physical activity levels, contribution of walking to overall physical activity and the types of options for walking that are available to residents in these two very different types of communities.

Another finding from this thesis that merits further exploration in a rigorous way is the fact that routes that have few or more gradual turns are used more for goal oriented exercise while routes with many turns or changes in directions may be more amenable for leisure walking. One way to examine this proposition in a more objective way would be consider the axial line rather than the line segment as the unit of analysis and recode all the data based on that assumption. The axial line is the longest line through a convex space, thus it will more accurately capture the importance, if any, of changes in direction of travel. Also, more detailed surveys could be conducted among residents to ascertain the specific purpose of their recreational walk.

In summary, this thesis was aimed at understanding how path characteristics shaped route choice for walking and to assist in the formulation of strategic choices that could be used to design retirement communities that supported walking among older adults living in retirement communities. The study shows that path choice for walking to destinations is shaped by practical considerations of distance and convenience and largely determined by the relative location of destination and origin. On the other hand, route choice for recreational walking is more complex and is determined by local, relational and structural environmental characteristics of the path segments that comprise the routes as well as characteristics of the residents themselves. Residents tended to choose routes of different difficulty level for walking based on their physical abilities and health. This study also found that many residents choose to walk indoors for recreation, especially along corridors between resident apartments. Understanding how the different factors together shape route choice leads to the clarification of design alternatives. This study suggests that designing campuses to support walking involves not only a careful consideration of individual local path characteristics but also an understanding how path segments and routes fit within the larger network of path segments on campus. Further, it is important to design routes with a range of characteristics and a range of challenge so that residents have many options to choose from and they have the option to move from one level of challenge to a higher one when they feel ready.

APPENDIX A: DATA COLLECTION INSTRUMENTS AND SUPPORTING DOCUMENTS

A.1: Example of resident questionnaire used in study (PS)……………………………332

A.2: IPAQ tool and IPAQ scoring instructions……………………………………...342

A.3: Path assessment checklist………………………………………………………355

A.4: Definition of terms in path assessment checklist……………………………….357

A.5: SPACES instrument…………………………………………………………….367

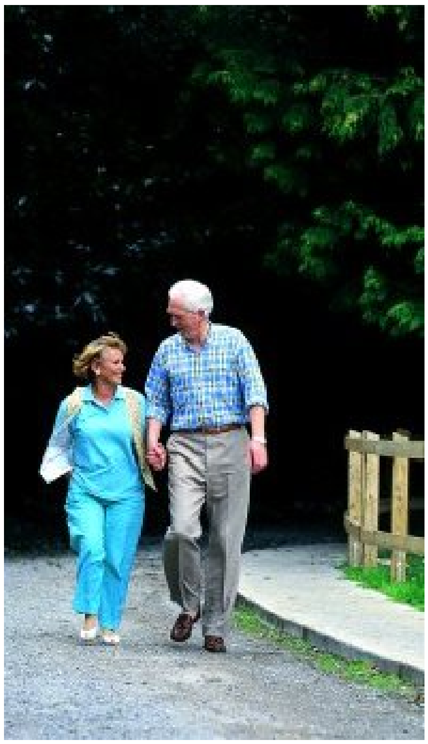
A.6: Irvine-Minnesota Inventory…………………………………………………….370

A.7: Facility Information Questionnaire……………………………………………..379

APPENDIX A.1

Community Name: Park Springs (1000, 2000, 3000 buildings)

ID#:



Walking Route Assessment Questionnaire

Researchers:
Anjali Joseph, Georgia Tech
Dr. Craig Zimring, Georgia Tech

Hello! We need your help to understand where people walk in retirement communities. This will help us design communities that support active living among residents and staff.

INFORMED CONSENT FORM
Principal Investigator: Dr. Craig Zimring
Co-investigator: Anjali Joseph (doctoral candidate)

You are being asked to be a volunteer in a research study. The purpose of this study is to understand how walking paths on retirement campuses influence where and how often residents walk. Around 100 residents from your community are expected to participate in this study. You are being asked to be in this study because you are a resident. This study is open to all independent living residents from your community.

If you decide to be in this study, your part will involve giving information to the researcher about where you walk on campus and how often you travel those routes on a regular basis. You will be asked to fill out a questionnaire form in a group session. The researcher will be present to provide guidance and help in filling out the form. Other residents in the group session will be aware of your participation, though your responses will be kept private. It should not take more than forty five minutes of your time to fill out the questionnaire form and mark your responses on the maps provided to you. Risks involved in participating in this study are no greater than those involved in daily activities such as doing a crossword puzzle.

As a result of your being in this study, we will know more about how campuses can be designed to support walking and this information may be used by your community and others in future campus development. You will not be paid for participating in this study as this is a student research project. There are no costs to you for participating in this study except for your time.

Your participation in this study is voluntary. You do not have to be in this study if you do not want to be. You have the right to change your mind and leave this study at any time without giving any reason, and without any penalty. Any new information that may make you change your mind about being in this study will be given to you. You will be given a copy of the consent form to keep. You do not waive any of your legal rights by signing this form.

If you have any questions about this study, you may contact Dr. Craig Zimring at (404) 894-3915. If you have any questions about your rights as a research subject, you may contact Melanie Clark or Alice Basler at Georgia Institute of Technology at (404) 894-6942.
If you sign below, it means that you have read (or have read to you) the information given in this consent form, and you would like to be a volunteer in this study.

Subject Name ____

Subject Signature ______________________________ Date ______________

Section 1: About you

1. Age: ____________________

2. Gender: __________________ M/F

3. Building number _____________________________________

4. Apartment number _____________________________________

5. How long have you lived at Park Springs?

   ☐ Less than 6 months

   ☐ Six months to 1 year

   ☐ 1 to 3 years

   ☐ 3 to 5 years

   ☐ More than 5 years

6. Do you use a cane or walker for walking?

   ☐ Yes

   ☐ No

7. Do you an electronic cart or amigo to get around campus?

   ☐ Yes, most of the time

   ☐ Yes, some of the time

   ☐ No

Section 2: Where you walk

Walking to destinations

8. Did you walk to the dining room in the last 7days?

   ☐ Yes → How many times did you walk there? ________

   ☐ No

Please think of the LAST TIME you walked to the dining room in the last seven days:

9. On your **way to the dining room** from your apartment did you:

    ☐ Walk indoors across the bridge to the clubhouse

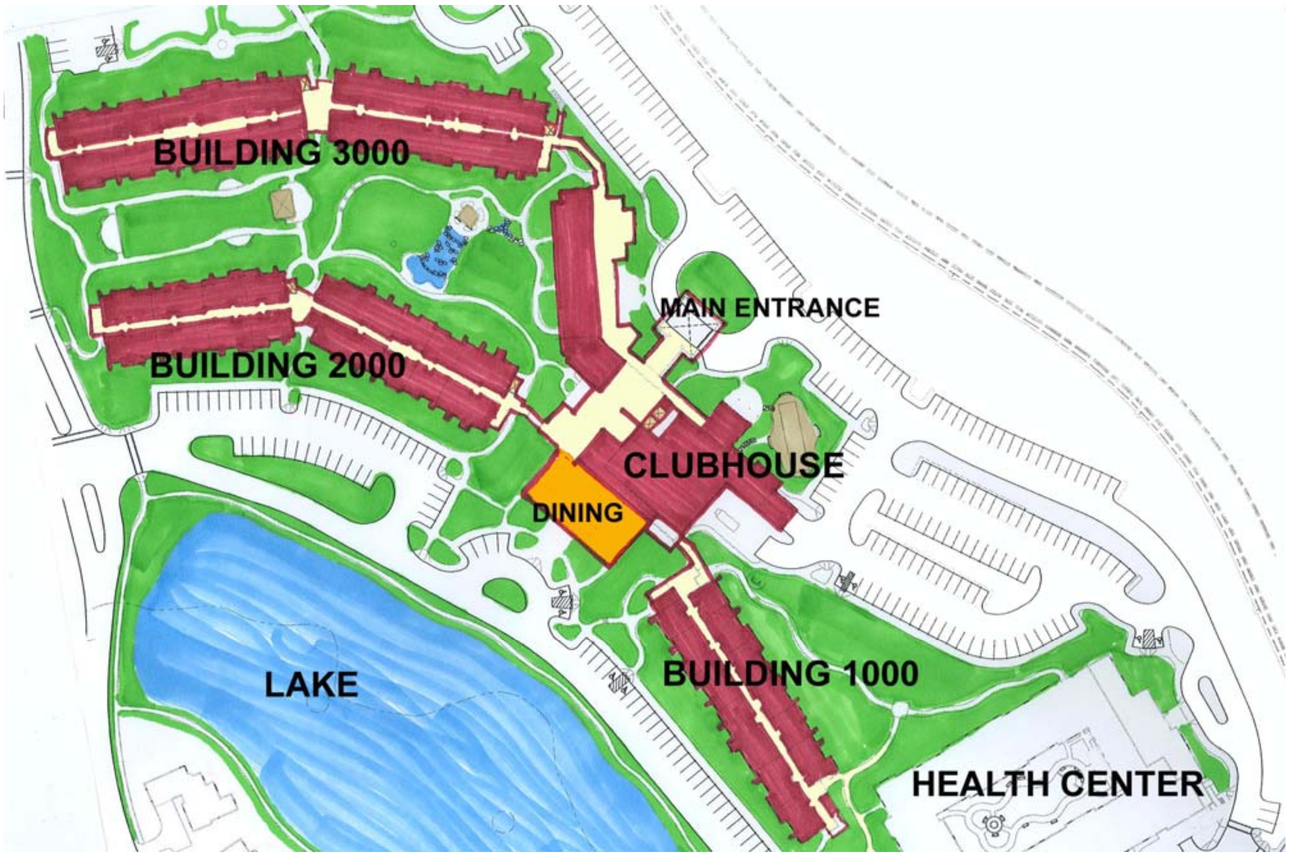
    ☐ Take an outdoor path to the clubhouse

10. If you walked indoors to the clubhouse, at what clubhouse level did you enter:

    ☐ Second floor

    ☐ Third floor

11. If you took an outdoor path to the clubhouse please mark your route on the map below:



CAMPUS MAP SHOWING PARKVIEW VILLAS AND CLUBHOUSE

12. Once you reached the clubhouse, how did you get to the third floor? You took:
    - ☐ Stairs
    - ☐ Elevators
    - ☐ None, I entered the clubhouse on the third floor

13. On your way back to your apartment from the dining room, did you:
    - ☐ Walk indoors across the bridge to your apartment building
    - ☐ Take an outdoor path to your apartment building

14. If you walked along an outdoor path to your apartment building, please mark on the map (on page 4) the route you took

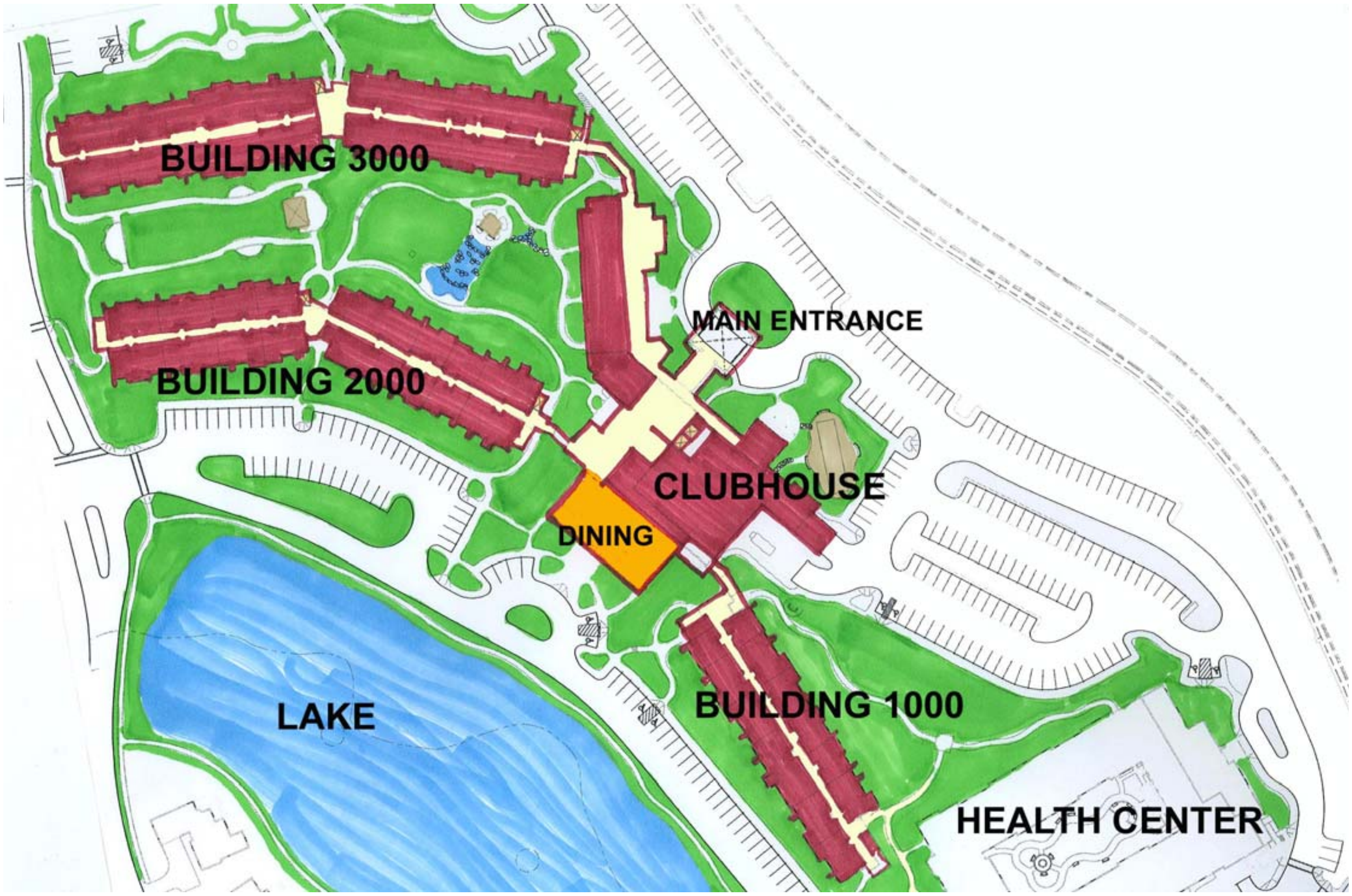
Other destinations

15. Did you walk to any of these places in the clubhouse in the last 7 days? If yes, how many times did you walk there?

Place	Yes/No	How many times in the last 7 days?
Community Hall		
Activity room		
Bank		
General Store		
Beauty Salon/ Barber		
Mail room		
Card room		
Billiard room		

16. When you walk to any of the places listed above do you usually take the same route that you take to get to the dining room?
    - ☐ Yes
    - ☐ No

17. If no, please mark the alternative route/routes that you take on the map below.



CAMPUS MAP SHOWING PARKVIEW VILLAS AND CLUBHOUSE

Walking for Exercise or Pleasure

18. Did you walk for exercise or fun for at least 10 minutes at a time at any place outside Park Springs (e.g. at a mall)?

- ☐ No
- ☐ Yes ⟶ Where? ______________________________

WALKING INDOORS at Park Springs

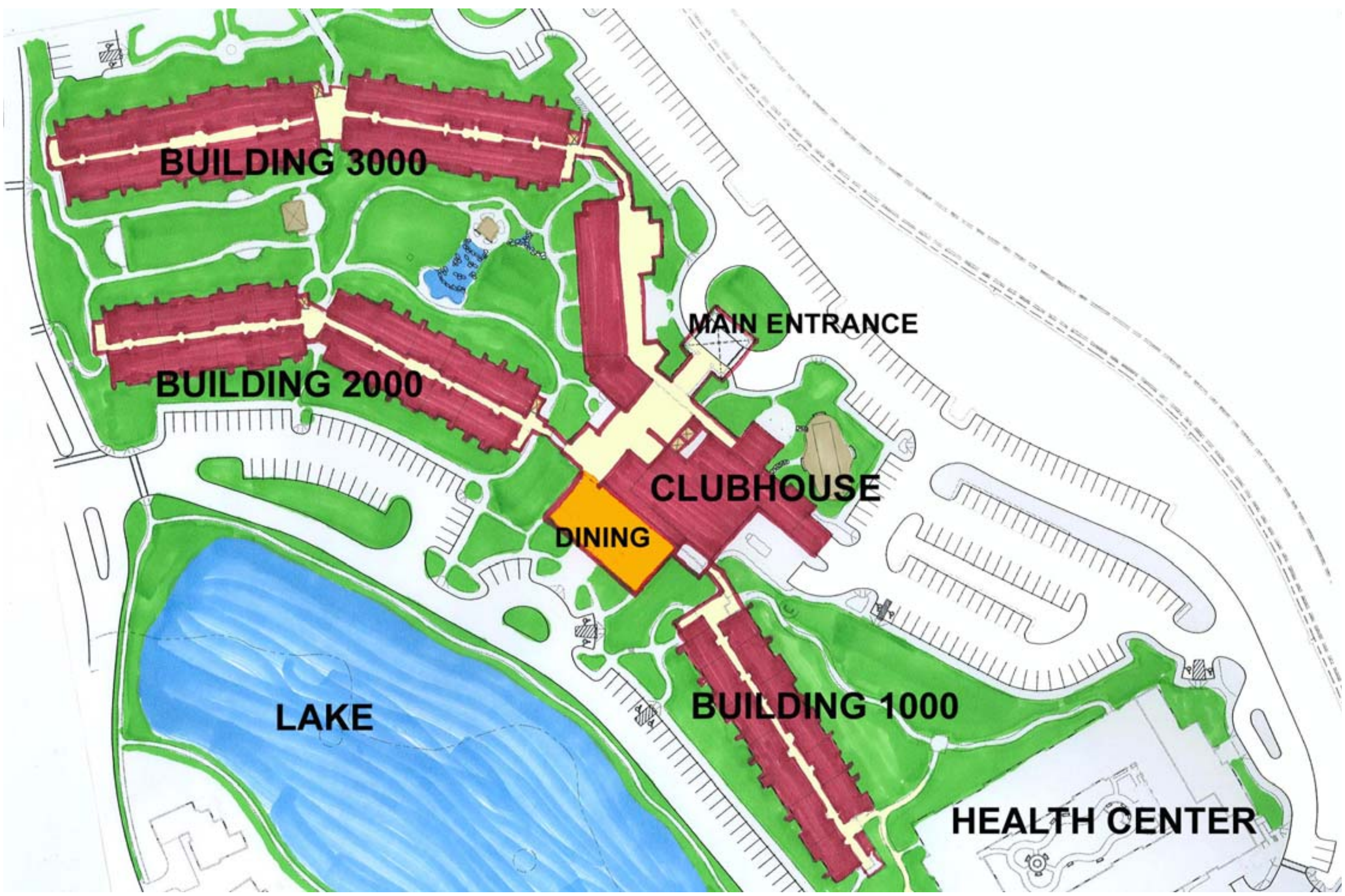
19. Did you walk for exercise or fun <u>indoors</u> at Park Springs for at least 10 minutes at a time anytime in the last seven days?

- ☐ Yes ⟶ How many times in the last 7 days?_________
- ☐ No ⟶ Go to Q. 23

20. Please mark on the map below where you walked when you took a walk indoors.

21. During your walk, how many times did you repeat your path?

________________ times



WALKING OUTDOORS at Park Springs

22. Did you walks outdoors for exercise or fun for at least 10 minutes at a time anytime in the past week?

☐ Yes ⟶ How many times in the past week? ________

☐ No

23. Please mark on the map of the Park Springs the route you took the LAST time you walked outdoors.

CAMPUS MAP, PARK SPRINGS

Section 3: Questions about physical activity

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

24. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

    _____ **days per week**

    ☐ No vigorous physical activities ➞ ***Skip to question 30***

25. How much time did you usually spend doing **vigorous** physical activities on one of those days?

    _____ **hours per day**

    _____ **minutes per day**

    ☐ Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

26. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

    _____ **days per week**

    ☐ No moderate physical activities ➞ ***Skip to question 32***

27. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

28. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ **days per week**

☐ No walking → ***Skip to question 7***

29. How much time did you usually spend **walking** on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

30. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

Thank you for completing this survey!

APPENDIX A.2: IPAQ INSTRUMENT AND SCORING INSTRUCTIONS

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE (August 2002)

SHORT LAST 7 DAYS SELF-ADMINISTERED FORMAT

FOR USE WITH YOUNG AND MIDDLE-AGED ADULTS (15-69 years)

The International Physical Activity Questionnaires (IPAQ) comprises a set of 4 questionnaires. Long (5 activity domains asked independently) and short (4 generic items) versions for use by either telephone or self-administered methods are available. The purpose of the questionnaires is to provide common instruments that can be used to obtain internationally comparable data on health–related physical activity.

Background on IPAQ

The development of an international measure for physical activity commenced in Geneva in 1998 and was followed by extensive reliability and validity testing undertaken across 12 countries (14 sites) during 2000. The final results suggest that these measures have acceptable measurement properties for use in many settings and in different languages, and are suitable for national population-based prevalence studies of participation in physical activity.

Using IPAQ

Use of the IPAQ instruments for monitoring and research purposes is encouraged. It is recommended that no changes be made to the order or wording of the questions as this will affect the psychometric properties of the instruments.

Translation from English and Cultural Adaptation

Translation from English is supported to facilitate worldwide use of IPAQ. Information on the availability of IPAQ in different languages can be obtained at www.ipaq.ki.se. If a new translation is undertaken we highly recommend using the prescribed back translation methods available on the IPAQ website. If possible please consider making your translated version of IPAQ available to others by contributing it to the IPAQ website. Further details on translation and cultural adaptation can be downloaded from the website.

Further Developments of IPAQ

International collaboration on IPAQ is on-going and an ***International Physical Activity Prevalence Study*** is in progress. For further information see the IPAQ website.

More Information

More detailed information on the IPAQ process and the research methods used in the development of IPAQ instruments is available at www.ipaq.ki.se and Booth, M.L. (2000). *Assessment of Physical Activity: An International Perspective*. Research Quarterly for Exercise and Sport, 71 (2): s114-20. Other scientific publications and presentations on the use of IPAQ are summarized on the website.

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

   _____ **days per week**

   ☐ No vigorous physical activities → ***Skip to question 3***

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

   _____ **hours per day**

   _____ **minutes per day**

   ☐ Don’t know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

   _____ **days per week**

   ☐ No moderate physical activities → ***Skip to question 5***

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ **days per week**

☐ No walking → ***Skip to question 7***

6. How much time did you usually spend **walking** on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

This is the end of the questionnaire, thank you for participating.

August 2003

Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire (IPAQ) - Short Form

Introduction

This document provides an outline to the scoring of the International Physical Activity Questionnaire (IPAQ) short form [available on the website www.ipaq.ki.se]. There are many different ways to analyse data on physical activity, but to-date there is no consensus on a 'correct' method for defining or describing levels of activity based on self–report surveys. The use of different scoring protocols makes it very difficult to compare within and between countries, even when the same instrument has been used.

This document describes several different methods of scoring the data derived from the telephone or interview administered IPAQ short form instrument. Use of these methods will enhance the comparability between surveys, provided identical methods have been used.

IPAQ is an instrument designed primarily for population surveillance of adults. It has been developed and tested for use in adults (age range of 15-69 years) and until further development and testing is undertaken the use of IPAQ with older and younger age groups is not recommended. IPAQ is being used also as an evaluation tool in some intervention studies, but the range of domains and types of activities included in IPAQ should be carefully noted before using it in this context.

Characteristics of the IPAQ short-form instrument:

1) IPAQ assesses physical activity undertaken across a comprehensive set of domains including leisure time, domestic and gardening (yard) activities, work-related and transport-related activity;

2) The IPAQ short form asks about three specific types of activity undertaken in the three domains introduced above and sitting. The specific types of activity that are assessed are walking, moderate-intensity activities and vigorous intensity activities; frequency (measured in days per week) and duration (time per day) are collected separately for each specific type of activity.

3) The items were structured to provide separate scores on walking; moderate-intensity; and vigorous-intensity activity as well as a combined total score to describe overall level of activity. Computation of the total score requires summation of the duration (in minutes) and frequency (days) of walking, moderate-intensity and vigorous-intensity activity;

4) Another measure of volume of activity can be computed by weighting each type of activity by its energy requirements defined in METS (METs are multiples of the resting metabolic rate) to yield a score in MET–minutes. A MET-minute is computed by multiplying the MET score by the minutes performed. MET-minute scores are equivalent to kilocalories for a 60 kilogram person. Kilocalories may be computed from MET-minutes using the following equation: MET-min x (weight in kilograms/60 kilograms). The selected MET values were derived from work undertaken during the IPAQ Reliability Study undertaken in 2000-2001. Using the Ainsworth et al. Compendium (*Med Sci Sports Med* 2000) an average MET score was derived for each type of activity. For example; all types of walking were included and an average MET value for walking was created. The same procedure was undertaken for moderate-intensity activities and vigorous-intensity activities. These following values continue to be used for the analysis of IPAQ data: Walking = 3.3 METs, Moderate PA = 4.0 METs and Vigorous PA = 8.0 METs.

Analysis of IPAQ

Both categorical and continuous indicators of physical activity are possible from the IPAQ short form. However, given the non-normal distribution of energy expenditure in many populations, the continuous indicator is presented as median minutes or median MET–minutes rather than mean minutes or mean MET-minutes.

Categorical score

Regular participation is a key concept included in current public health guidelines for physical activity.[1] Therefore, both the total volume and the number of day/sessions are included in the IPAQ analysis algorithms. There are three levels of physical activity proposed to classify populations; these are [i] 'Insufficiently active', [ii] 'sufficiently active', [iii] and 'high active'. The criteria for these three levels are shown below.

1. Insufficiently Active (CATEGORY 1)

This is the lowest level of physical activity. Those individuals who not meet criteria for Categories 2 or 3 are considered '**insufficiently active'** [CATEGORY 1].

2. Sufficient Active (CATEGORY 2)

The minimum pattern of activity to be classified as 'sufficiently active' is any one of the following 3 criteria:

a) 3 or more days of vigorous activity of at least 20 minutes per day **OR**
b) 5 or more days of moderate-intensity activity or walking of at least 30 minutes per day **OR**
c) 5 or more days of any combination of walking, moderate-intensity or vigorous intensity activities achieving a minimum of at least 600 MET-min/week.

Individuals meeting at least one of the above criteria would be defined as achieving the minimum recommended to be considered '**sufficiently active'** [CATEGORY 2]. This category is more than the minimum level of activity recommended for adults in current public health recommendations. IPAQ measures total physical activity whereas the recommendations are based on activity (usually leisure-time or recreational) over and above usual daily activities.

3. High Active (CATEGORY 3)

A separate category labeled '**highly active'** [CATEGORY 3] can be computed for people who exceed the minimum public health physical activity recommendations. This is a useful indicator because it is known that higher levels of participation can provide greater health benefits, although there is no consensus on the exact amount of activity for maximal benefit. In the absence of any established criteria, the International Coordinating Group for the development of IPAQ proposes a measure which equates to approximately at least one hour per day or more, of at least moderate-intensity activity. It is desirable to have a 'high active' category, because in some populations, a large proportion of the population may be classified as "sufficiently active' because the IPAQ instrument assess all domains of activity. Category 3 sets a higher threshold of activity and provides a useful mechanism to distinguish variation in sub-population groups.
The two criteria for classification as 'highly active' are:

[1] Pate RR, Pratt M, Blair SN, Haskell WL , Macera CA, Bouchard C et al. Physical activity and public health. A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *Journal of Amercian Medical Association* 1995; 273(5):402-7. and U.S.Department of Health and Human Services. *Physical Activity and Health: A Report of the Surgeon General.* Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, The Presidents' Council on Physical Fitness and Sports: Atlanta, GA:USA. 1996.

a) vigorous-intensity activity on at least 3 days achieving a minimum of at least 1500 MET-minutes/week **OR**
b) 7 or more days of any combination of walking, moderate-intensity or vigorous intensity activities achieving a minimum of at least 1500 MET-minutes/week

<u>Continuous score</u>

Data collected with IPAQ can be reported as a continuous measure and reported as median MET-minutes. Median values can be computed for walking (W), moderate-intensity activities (M), and vigorous-intensity activities (V) using the following formulas:

MET values and Formula for computation of Met-minutes

Walking MET-minutes/week = 3.3 * walking minutes * walking 'days'
Moderate MET-minutes/week = 4.0 * moderate-intensity activity minutes * moderate days
Vigorous MET-minutes/week = 8.0 * vigorous-intensity activity minutes * vigorous-intensity days

A combined total physical activity MET-min/week can be computed as the sum of Walking + Moderate + Vigorous MET-min/week scores.

The MET values used in the above formula were derived from the IPAQ validity and reliability study undertaken in 2000-2001 [2]. A brief summary of the method is provided above (see page 1).

As there are no established thresholds for presenting MET-minutes, the IPAQ Research Committee proposes that these data are reported as comparisons of median values and interquartile ranges for different populations.

<u>IPAQ Sitting Question</u>

The IPAQ sitting question is an additional indicator variable and is not included as part of any summary score of physical activity. Data on sitting should be reported as median values and interquartile range. To-date there are few data on sedentary (sitting) behaviors and no well-accepted thresholds for data presented as categorical levels.

<u>Data Processing Rules</u>

In addition to a standardized approach to computing categorical and continuous measures of physical activity, it is necessary to undertake standard methods for the cleaning and treatment of IPAQ datasets. The use of different approaches and rules would introduce variability and reduce the comparability of data.

There are no established rules for data cleaning and processing on physical activity. Thus, to allow more accurate comparisons across studies IPAQ has established and recommends the following guidelines:

1. Data cleaning

- time should be converted from hours and minutes into minutes
- ensure that responses in 'minutes' were not entered in the 'hours' column by mistake during self-completion or during data entry process, values of '15', '30', '45', '60' and '90' in the 'hours' column should be converted to '15', '30', '45', '60' and '90' minutes, respectively, in the minutes column.
-

[2] Craig *CL,Marshall A , Sjostrom M* et al. International Physical Activity Questionnaire: 12 country reliability and validity Med Sci Sports Exerc 2003;August, in press

- time should be converted to daily time [usually is reported as daily time, but a few cases will be reported as optional weekly time – eg. VWHRS, VWMINS – convert to daily time]
- convert time to mets-mins [see above; days x daily time]
- must have the number of days for the day variables; for the 'time' variables, either daily or weekly time is needed – if 'don't know' or 'refused ' or data are missing in walking, moderate or vigorous days or minutes, then that case is removed from analysis

2. Maximum Values for excluding outliers
This rule is to exclude data which are unreasonably high; these data are to be considered outliers and thus are excluded from analysis. All Walking, Moderate and Vigorous time variables which total at least or greater than '16 hours' should be excluded from the analysis.
The 'days' variables can take the range 0-7 days, or 8,9 (don't know or refused); values greater than 9 should not be allowed and those data excluded from analysis.

3. Truncation of data rules
This rule is concerned with data truncation and attempts to normalize the distribution of levels of activity which are usually skewed in national or large population data sets. It is recommended that all Walking, Moderate and Vigorous time variables exceeding ' 2 hours' or '120 minutes' are truncated (that is re-coded) to be equal to '120 minutes' in a new variable. This rule permits a maximum of 14 hours of activity in a week to be reported for each category of physical activity. *This rule requires further testing, but is an initial manner proposed for classifying these population data.*

When analysing IPAQ data and presenting the results in categorical variables, this rule has the important effect of preventing misclassification in the 'high active' category. For example, an individual who reports walking for 10 minutes on 6 days and 6 hours of moderate activity on another day could be coded as 'highly active' because this pattern meets the '7 day" and "1500 MET-min" criteria for 'high active'. However, this uncommon pattern of activity is unlikely to yield the health benefits that the 'high active' category is intended to represent. Applying the truncation rule will not prevent an individual reaching the criteria for 'sufficiently active'.

When analysing IPAQ data and presenting the results as a continuous variable using the median value, application of the truncation rule will produce lower values than would otherwise be obtained.

4. Minimum Values for Duration of Activity
Only values of 10 or more minutes of activity will be included in the calculation of summary scores. The rationale being that the scientific evidence indicates that episodes or bouts of at least 10 minutes are required to achieve health benefits. Responses of less than 10 minutes [and their associated days] should be re-coded to 'zero'.

Summary of Data Processing Rules 1- 4 above
Data management rules 2, 3, and 4 deal with first excluding outlier data, then secondly, recoding high values to '2 hours', and finally describing minimum amounts of activity to be included in analyses. These rules will ensure that highly active people remain highly active, while decreasing the chances that less active individuals are coded as highly active.

5. Calculating Total Days for 'Sufficient Active' [category 2] and 'Highly Active' [category 3]

Presenting IPAQ data using categorical variables requires the total number of 'days' on which all physical activity was undertaken to be assessed. This is difficult because frequency in 'days' is asked separately for walking, moderate-intensity and vigorous-intensity activity, thus allowing the total number of 'days' to range from a minimum of 0 to a maximum of 21'days' per week. The IPAQ instrument does not record if different types of activity are undertaken on the same day.

In calculating **'sufficient activity'**, the primary requirement is to identify those individuals who undertake a combination of walking and/or moderate-intensity activity on <u>at least '5 days'/week</u>. Individuals who meet this criterion should be coded in a new variable called "*at least five days"*.

Below are two examples showing this coding in practice:

i) an individual who reports '2 days of moderate' and '3 days of walking' should be coded as a value indicating "*at least five days"*;

ii) an individual reporting '2 days of vigorous', '2 days walking' and '2 days moderate' should be coded as a value to indicate "*at least five days"* [even though the actual total is 6].

The original frequency of 'days' for each type of activity should remain in the data file for use in the other calculations.

The same approach as described above is used to calculate total days for computing the '**highly active'** category. The primary requirement according to the stated criteria is to identify those individuals who undertake a combination of walking, moderate-intensity and or vigorous activity on <u>at least 7 days/week</u>. Individuals who meet this criterion should be coded in a value in a new variable to reflect *"at least 7 days*".

Below are two examples showing this coding in practice:

i) an individual who reports '4 days of moderate' and '3 days of walking' should be coded as the new variable *"at least 7 days*".

ii) an individual reporting '3 days of vigorous', '3 days walking' and '3 days moderate' should be coded as *"at least 7 days*" [even though the total adds to 9] .

Summary: The algorithm(s) in Appendix 1 and Appendix 2 to this document show how these rules work in an analysis plan, to develop the categories 1 [insufficient], 2 [sufficient], and 3 [high] levels of activity. A short form ['at a glance'] and a diagram showing these analytic steps for 'sufficient physical activity' and 'high active' categories are shown as appendix 1 at the end of this document.

IPAQ Research Committee
August 2003

APPENDIX 1

At A Glance
IPAQ Scoring Protocol (Short Versions)

Categorical Score- three levels of physical activity are proposed

1. *Insufficiently Active*

- No activity is reported **OR**
- Some activity is reported but not enough to meet Categories 2 or 3.

2. *Sufficiently Active*

Any one of the following 3 criteria

- 3 or more days of vigorous activity of at least 20 minutes per day **OR**
- 5 or more days of moderate-intensity activity or walking of at least 30 minutes per day **OR**
- 5 or more days of any combination of walking, moderate-intensity or vigorous intensity activities achieving a minimum of at least 600 MET-min/week.

3. *Highly Active*

Any one of the following 2 criteria

- Vigorous-intensity activity on at least 3 days and accumulating at least 1500 MET-minutes/week **OR**
- 7 or more days of any combination of walking, moderate-intensity or vigorous intensity activities achieving a minimum of at least 1500 MET-minutes/week

Continuous Score

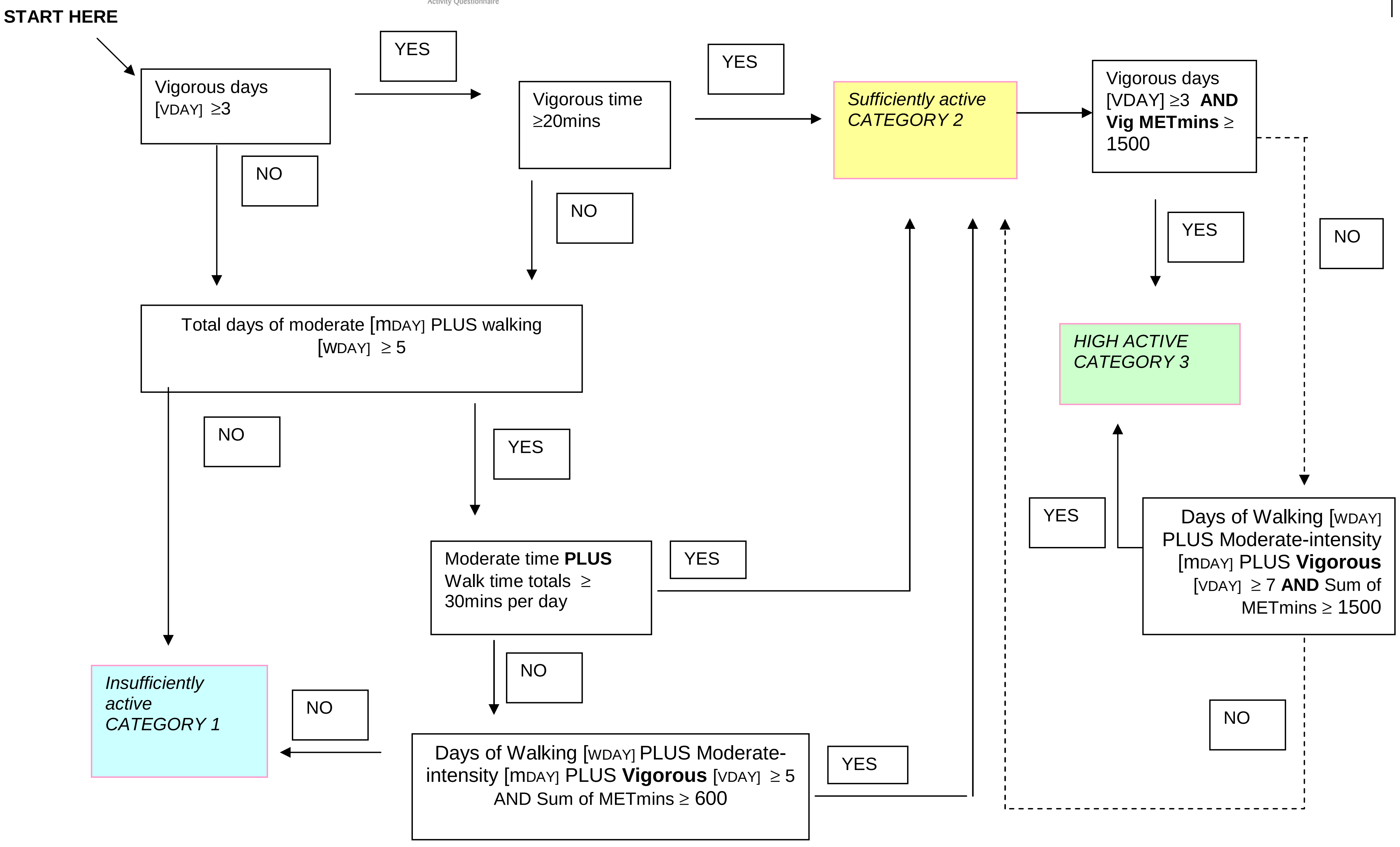
Expressed as MET-min per week: MET level x minutes of activity x events per week

Sample Calculation

MET levels	**MET-min/week for 30 min episodes, 5 times/week**
Walking = 3.3 METs	3.3*30*5 = 495 MET-min/week
Moderate Intensity = 4.0 METs	4.0*30*5 = 600 MET-min/week
Vigorous Intensity = 8.0 METs	8.0*30*5 = 1,200 MET-min/week
	TOTAL = 2,295 MET-min/week

Total MET-min/week = (Walk METs*min*days) + (Mod METs*min*days) + Vig METs*min*days)

Please review the document "Guidelines for the data processing and analysis of the International Physical Activity Questionnaire (Short Form)" for more detailed description of IPAQ analysis and recommendations for data cleaning and processing [www.ipaq.ki.se].



APPENDIX 2: Flow chart algorithm for the analysis of IPAQ short form

APPENDIX A.3: PATH ASSESSMENT CHECKLIST

Community Name:
Segment ID:
Street Name (if relevant):

1. Type of path
- ☐ Internal path
- ☐ Outdoor path
- ☐ Transition path

2. Path Width ______________

3a. Path location (outdoor paths)
- ☐ Sidewalk next to road
- ☐ Sidewalk within 1m of kerb
- ☐ Shared path with markings
- ☐ Shared path , no markings
- ☐ Path/trail through park
- ☐ Access lane
- ☐ road crossover
- ☐ Other

3b. Path location (internal paths)
- ☐ Path between resident apts.
- ☐ Path through public spaces
- ☐ Connection between building
- ☐ Stair
- ☐ Other

4. Path material

4a. External
- ☐ Continuous concrete
- ☐ Concrete slabs
- ☐ Paving bricks
- ☐ Gravel
- ☐ Bitumen
- ☐ Grass or sand
- ☐ Wood planks
- ☐ Under repair

4b. Internal
- ☐ Carpet
- ☐ Vinyl
- ☐ Tile
- ☐ Hardwood
- ☐ Stone
- ☐ Brick

5. Path Slope
- ☐ Flat or gentle
- ☐ Moderate slope
- ☐ Steep

6. Path condition
- ☐ Poor
- ☐ Moderate
- ☐ Good
- ☐ Under repair

7. Are there curb cuts at all places where crossing is expected to happen? (E)

☐ Yes ☐ No

8. Is there a street crossing in this segment? (E)

☐ Yes ☐ No

9. Are there any permanent path obstructions on this segment (e.g. poles, paths, furniture)

☐ Yes ☐ No

10. Are there steps in this segment?

☐ Yes ☐ No

11. If steps are present, are there alternatives to negotiating the change of grade?

☐ Yes ☐ No

12. Continuity of path
- ☐ Path forms useful and direct route
- ☐ Path is disjointed

13. How much of the path is covered by these features that provide protection from sun, rain, and/or snow

Feature	None	Partly	Fully
Roof & walls			
Arcades			
Awnings			
Trees			

14. Is there glare along this path?

☐ Yes ☐ No

Transition segments only:

15. Is there a smooth threshold while moving from inside to outside or vice versa

☐ Yes ☐ No

16. Is a key or identification card required to enter inside?

☐ Yes ☐ No

17. Is there an automatic door or button press door available for getting in and out?

☐ Yes ☐ No

18. Indicate whether the following amenities are present on the segment. Indicate the number of each feature present in the segment
- ☐ Benches/chairs/ledges ________
- ☐ Trash cans ________
- ☐ Water fountain ________
- (I) ☐ Handrails ________

19. Are destinations present in the segment?

☐ Yes ☐ No

20. Type of destination
- ☐ Residential
- ☐ Shops
- ☐ Activity related areas
- ☐ Chapel
- ☐ Beauty salon
- ☐ Administrative areas
- ☐ Natural features
- ☐ Parking

21.Type of views
- ☐ Residential
- ☐ Water (river, lake)
- ☐ Tended nature
- ☐ Nature (untended)
- ☐ Public spaces (plaza, lobby)
- ☐ Destinations (not on path)
- ☐ Parking ☐ Art

APPENDIX A.4: PATH ASSESSMENT CHECKLIST – DEFINTION OF TERMS

Definitions for terms in path assessment form

Path Segment:

A **path segment** is a section of the path between two decision points. That is, a path segment ends whenever the need arises to make a decision about the path of travel (e.g. at an intersection). If steps are encountered along a path of travel – it is considered part of the path (segment 2 in Figure 1). If a flight of stairs is encountered off the path of travel (segment 3 in Figure 1), it counts as a decision point and will be regarded as a separate segment (connecting two different floor levels)

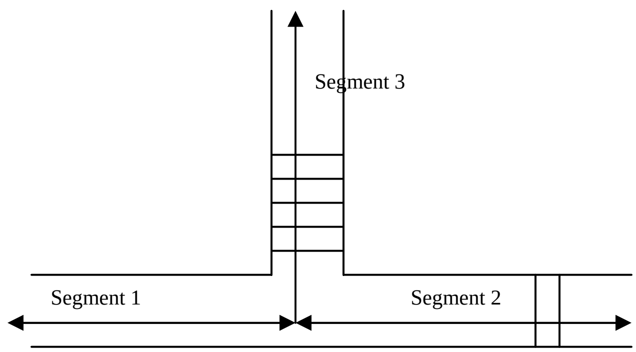


Figure 1: Definition of path segment used in this study

Procedure:

1. Walk across campus with building plan in hand and identify if there are any discrepancies between what is on the plan and what is on site. For example, new paths may have been added on site and may not have been updated on the plan.

2. Take the campus site plan and building plans of buildings on campus (modified as needed to accommodate any changes) and mark all possible path segments on it based on the above definition of segment. Building level segments may be difficult to mark on a campus level plan due to scale issues. These can be marked on separate building level plans. Make sure that connections between outdoor and indoor path segments are clearly marked. Each segment should be given a unique identification number (e.g. PVX1 – external path segment no. 1 at PV)

3. Conduct path assessment by walking along each path segment and noting its characteristics on the path assessment form. Make sure to mark the campus ID and segment ID on each form.

Definition for path assessment variables

1. Type of path:
   - Internal – located indoors within buildings
   - External – located outdoors, outside buildings
   - Transition path – located at the connections between indoor and outdoor, i.e. path segments leading from inside to outside and vice versa

2. Path Width: measure using a tape measure wherever possible

3. a. Path location of outdoor path segments:
   - Sidewalk next to road: Sidewalk by the side of the road
   - Sidewalk within 1m of kerb: Sidewalk is located 1m from kerb
   - Shared path with markings: path used by a range of users including pedestrians, bicycles, small wheeled vehicles and cars; with center line logos and other pavement markings included for convenience
   - Shared path , no markings: path used by a range of users including pedestrians, bicycles, small wheeled vehicles and cars
   - Path/trail through park: paved path or trail through landscaped green areas or through forested areas
   - Access lane: Paved paths leading from sidewalks or nature trails to the road

3b. Path location of indoor path segments:

   - Between resident apartments: indoor path with resident apartments on both sides
   - Through public spaces: path passing through public spaces (e.g. reception, lounge, cafeteria)
   - Internal stair: indoor fire stair or ceremonial staircase
   - Indoor connection between buildings: indoor paths connecting two different buildings

Figure 2: path between resident apartments
Figure 3: path through public spaces
Figure 4: indoor connection between buildings

4. Path slope: how steep is the path segment? (from SPACES)
    - Flat or gentle slope: when the path has no slope or a slight or gradual incline (Figure 5)
    - Moderate slope: is one with medium incline (Fig 6)
    - Steep slope: is one with sharp or rapid incline (Fig. 7)

Figure 5: Flat path segment **Figure 6: moderately sloping path segment** **Figure 7: Steep path**

5. a. Path material for external path segments: what material is the outdoor path made up of?
    - Continuous concrete (fig. 8)
    - Concrete slabs (fig. 9)
    - Paving bricks (fig. 10)
    - Gravel (fig. 11)
    - Bitumen (fig 12)
    - Grass or sand (fig 13)
    - wooden planks(fig. 14)
    - Under repair: path is under repair

Figure 8: continuous concrete **Figure 9: concrete slabs** **Figure 10:paving bricks**

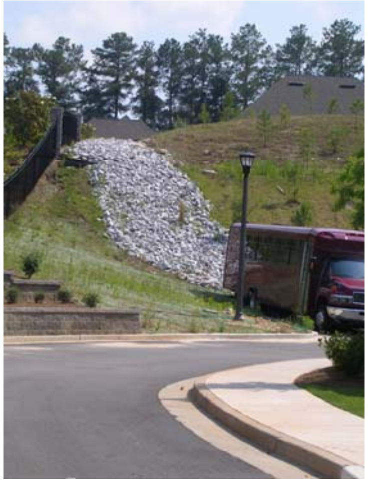


Figure 11: gravel

Figure 12: bitumen

Figure 13: grass or sand

Figure 14: wooden planks

5b. Path material of indoor path segments:

- Carpet
- Vinyl
- Tile
- Hardwood
- Stone
- Brick

6. Path condition: Is the path well-maintained (from SPACES)

- A <u>poor</u> path is one with a lot of bumps, cracks, holes and weeds growing in the surface or between the cracks. The crossover from the path to the street is rough, with large gaps or holes. (See Fig. 15)
- <u>A moderate</u> path is one with some bumps, cracks, holes and weeds growing in the surface or between the cracks but not as many as a poor path. The crossover from the path to the street is mostly smooth although there are some crossovers with holes or gaps. (See Fig. 16)
- A <u>good</u> path is one with very few bumps, cracks, holes and weeds growing in the surface or between the cracks. The crossover from the path to the street is smooth with no holes or gaps. (See Fig. 17)

Figure 15: poor condition

Figure 16: moderate condition

Figure 17: good condition

Figure 18: Street crossing

7. Street crossing: Whether a street crossing is part of the segment?
   - Yes (Figure 18)
   - No

8. Are there any path obstructions?

   - Yes (Figure 19)
   - No

Figure 19: Path obstruction

9. Are there any steps in this segment?
    - Yes
    - No

10. If steps are present, are there alternatives to negotiating the change of grade?
    - Mark 'Yes' if alternatives such as a ramp are within visual range
    - Mark 'No' if alternatives for changing levels is not easily visible)

11. Continuity of path segment: Is the path continuous
    - Yes – the path forms a useful, coherent and direct route to a destination.
    - No – the path is disjointed. It does not form any useful way to any destinations

12. **How much of the path is covered by these features that provide protection from sun, rain, and/or snow? (From IMI tool)**

    For each segment, determine how much of the sidewalk is covered by the following architectural elements that help provide protection from sun, rain, or snow. Mark all that apply:

    - <u>Roofs and walls:</u> If it is an indoor path covered by roof and walls on both sides
    - <u>Arcades</u>: A roof over the sidewalk or outdoor area. Arcades are made up of a series of arches covered by a roof and supported by columns They are typically connected to the building
    - <u>Awnings:</u> A roof-like cover or canopy that is fixed or collapsible, that comes out from the building over the sidewalk or outdoor area. Awnings are meant to provide protection from sun, rain or snow. They can be made of canvas, aluminum or other material.
    - <u>Trees</u>: Tree canopy provides protection from sun, rain or snow.

13. Is there glare along the path?
    - Yes, if the wall surfaces (windows) or floor surfaces appear bright and reflective
    - No, if the wall surfaces and floor surfaces are not reflective

14. Is there a smooth threshold while moving from inside to outside or vice versa?
    - Yes, if there is no level difference between indoor and outdoor surfaces (for example a step or change in level)
    - No, if one needs to negotiate change in level while moving from indoors to outdoors and vice versa

15. Is a key or identification card required to enter inside?
    - Yes, if doors are locked and can only be entered from outside by using some type of identification key or card

- No, if doors are not locked and no key is required for entry into the building from outside

16. Is there an automatic door or button press door available for getting in and out?
    - Yes, if doors have sensors and open automatically or if they have a button that can be pressed to open the door (handicapped access)
    - No, if doors can only be opened by manually pushing or pulling the door

17. Indicate whether the following amenities are present on the segment. Indicate the number of each feature present in the segment.
    - Note presence of each amenity and also how many are present in the segment

18. **Are destinations present in the segment?**
    - Yes, if a destination is present
    - No, if a destination is not present

19. **Type of destination present along the segment. Mark all the different types of destinations present along the segment**

    - Residential – resident apartments or cottages are located along the segment
    - Shops - gift shops located along segment
    - Activity related areas – such as dining room, mail room, billiards room, exercise rooms, swimming pool are located along segment
    - Chapel – church, chapel or room for religious services
    - Beauty salon
    - Administrative areas – administrative offices, reception desk are located along segment
    - Natural features – natural features such as gazebo, lake or waterfall are present
    - Parking – designated parking areas are located along segment

20. Types of different views that can be seen from the segment. Mark all that apply.
    - Residential
    - Water (river, lake)
    - Tended nature
    - Nature (untended)
    - Public spaces (plaza, lobby)
    - Destinations (not on path)
    - Parking
    - Artwork

Figure 20: residential views

Figure 21: Water views

Figure 22: tended nature views

Figure 23: untended nature views

Figure 24: view of public spaces

Figure 25: view of destinations not on path

Figure 26: Views of parking

Figure 27: Views of artwork

APPENDIX A.5: SPACES INSTRUMENT

SPACES FORM 1 ©2000

Auditor ID ________ Date ____________

Suburb ______________________________

Street ______________________________

Seg ID ______________________________

1a. Type of buildings/ features: ***(tick all applicable)***

	Side 1	Side 2
Transport infrastructure	0	0
Housing	1	1
Office	2	2
Convenience stores	3	3
Other retail	4	4
Industrial	5	5
Educational	6	6
Service	7	7
Natural features	8	8

1b. Predominant buildings/ features: *(tick ONE per side only)*

	Side 1	Side 2
Transport infrastructure	0	0
Housing	1	1
Office	2	2
Convenience stores	3	3
Retail	4	4
Industrial	5	5
Educational	6	6
Service	7	7
Natural features	8	8

1c. Are the predominant buildings/features the same for both sides?

Yes	1
No	2

A. Path for walking &/or cycling: *(only if a path present)*

2. Type of path:

	Side 1	Side 2
Go to section B ← No path	1	1
Footpath	2	2
Shared path – with markings	3	3
Shared path – no markings	4	4

3. Path location:

	Side 1	Side 2
Next to road	1	1
Within 1m of kerb	2	2
Between 1 & 2m of kerb	3	3
Between 2 & 3m of kerb	4	4
More than 3m from kerb	5	5

4. Path material:

	Side 1	Side 2
Continuous concrete	1	1
Concrete slabs	2	2
Paving bricks	3	3
Gravel	4	4
Bitumen	5	5
Grass or sand	6	6
Under repair	7	7

5. Slope:

	Side 1	Side 2
Flat or gentle	1	1
Moderate slope	2	2
Steep slope	3	3

6. Path condition & smoothness:

	Side 1	Side 2
Poor (a lot of bumps, cracks, holes & weeds)	1	1
Moderate (some bumps, cracks, holes & weeds)	2	2
Good (very few bumps, cracks, holes & weeds)	3	3
Under repair	4	4

7. Permanent path obstructions:

	Side 1	Side 2
Poles	1	1
Signs	2	2
Tables & chairs	3	3
Trees	4	4
None	5	5

B On-road *(all segments)*

8. Path type:

On-road cycle lane – marked	1
On-road – no lane marked	2

9. Slope: *(only assess on-road if no path is present)*

Flat or gentle slope	1
Moderate slope	2
Steep slope	3

10. Condition of road:

Poor (a lot of bumps, cracks, holes)	1
Moderate (some bumps, cracks, holes)	2
Good (very few bumps, cracks, holes)	3
Under repair	4

11. Number of lanes on road (in total):

1 lane	1
2 or 3 lanes	2
4 or 5 lanes	3
6 or more lanes	4

12. Vehicle parking restriction signs present:

	Side 1	Side 2
Yes	1	1
No	2	2

13. Kerb type:

	Side 1	Side 2
Mountable	1	1
Non-mountable	2	2
No kerb	3	3

14. Traffic control devices: *(tick all applicable)*

Roundabouts	1
Speed humps or ramps	2
Chicanes, chokers, kerb extensions or lane narrowing	3
Traffic signals	4
None	5

15. Other routes available:

Lane	1
Access lane through cul-de-sac/no through road	2
Path through park	3
None	4

16. Type of crossings:

Zebra or children	1
Traffic signals	2
Bridge/overpass	3
Underpass	4
None	5

17. Crossing aids: ***(tick all applicable)***

Median refuge or traffic island	1
Kerb extensions	2
None	3

18. Streetlights present?

	Side 1	Side 2
Yes	1	1
Go to Q20 ← No	2	2

19. Does lighting cover the path area?

	Side 1	Side 2
Yes	1	1
No	2	2

20. Are destinations present in segment?

Yes	1
Go to Q23 ← No	2

21. Number car parking facilities at destinations: *(approx.)*

	0 (1)	1-20 (2)	21-50 (3)	51-70 (4)	71-100 (5)	101+ (6)	
Shops							1
School							2
Other							3

22. Bike parking facilities:

Bike locker or enclosure	1
Bike parking or U rails	2
Rack or stand	3
None	4

23. Driveway crossovers:

Most buildings have one driveway	1
Approx. ½ buildings have one driveway	2
Approx ¼ buildings have one driveway	3
No driveways	4

24. Surveillance: (can be observed from a window, verandah, porch, garden)

Can be observed from more than 75% of buildings	1
Can be observed from between 50 – 74% of buildings	2
Can be observed from less than 50% of buildings	3
Not applicable	4

25. Garden maintenance: (well maintained = looks trim & clean, looks kept)

More than 75% well maintained	1
Between 50 –74% well maintained	2
Less than 50% well maintained	3
Not applicable	4

26. Verge maintenance: (well = looks trim & clean, looks kept)

More than 75% well maintained	1
Between 50 –74% well maintained	2
Less than 50% well maintained	3
Verge undergoing work	4
Not applicable	5

27. Number of verge trees:

	Side 1	Side 2
1 or more per house block	1	1
Approx. 1 tree for every 2 house blocks	2	2
Approx. 1 tree for every 3 or more house blocks	3	3
Go to Q29 ← No trees at all	4	4

28. Average height of trees:

	Side 1	Side 2
Small (head high)	1	1
Medium (between head & ceiling height)	2	2
Large (higher than a ceiling)	3	3

29. Cleanliness: (can you see any litter, rubbish, graffiti, broken glass, discarded items)

Yes lots	1
Yes some	2
None or almost none	3

30. Type of views: ***(tick all applicable)***

Urban (houses & household gardens)	1
Commercial (shops, light industrial, offices, schools)	2
Water (such as river, ocean, lake)	3
Tended nature (parks, community gardens tended, well maintained)	4
Nature (parks, community gardens where level of care differs)	5

31. How alike are the building designs?

All of similar design	1
Range of different designs	2
Not applicable (no buildings)	3

32. How attractive would you rate this segment for walking?

Very attractive	1
Attractive	2
Not attractive at all	3

33. How physically difficult would you rate this segment for walking?

Easy	1
Moderately difficult	2
Very difficult	3

34. How attractive would you rate this segment for cycling?

Very attractive	1
Attractive	2
Not attractive at all	3

35. How physically difficult would you rate this segment for cycling?

Easy	1
Moderately difficult	2
Very difficult	3

C. OVERALL ASSESSMENT

Auditor ID _________ Date ___________

Suburb ________________________________

Map ID ________________________________

36. Continuity of path

Path forms useful & direct route	☐	1
Path is disjointed	☐	2

37. Neighbourhood legibility – ease of finding your way around the neighbourhood

Very easy	☐	1
Fairly easy	☐	2
Not easy at all	☐	3

APPENDIX A.6: IRVINE MINNESOTA INVENTORY

SETTING: ________________________ SEGMENT ID __________ OBSERVER __________ DATE __________

***Answer questions 1-6 based on this end of the segment:* Intersection of _______ and _______**

NEIGHBORHOOD IDENTIFICATION

1. Are there **monuments or markers** including neighborhood entry signs that indicate that one is entering a special district or area? (Do not include park signs or other signs that do not indicate or demarcate a neighborhood or district)	Yes	No

STREET CROSSING

2a. Consider the places on the segment that are **intended** for pedestrians to cross the street. Are these places marked for pedestrian crossing?	**All** places where pedestrians can cross are marked for pedestrian crossing	
	Some of the places where pedestrians can cross are marked for pedestrian crossing	
	None of the places where pedestrians can cross are marked for pedestrian crossing	
	N/A (there is no street, or there are no places where pedestrian crossing is intended)	
If 2a = "None" or "N/A", mark box and skip to question 3.		☐
2b. What type of **marking** do the crosswalks have? Mark all that apply.	White painted lines	
	Colored painted lines	
	Zebra striping	
	Different road surface or paving (e.g. tiles, colored concrete, marble, etc)	
	Other	
3. Are there **curb cuts** at all places where crossing is expected to occur?	**All** expected crossing places have curb cuts	
	One or more expected crossing places are **missing** a curb cut(s)	
	N/A (no curbs or no expected crossing places)	
4. What type of **traffic/pedestrian signal(s)/system(s)** is/are provided? Mark all that apply.	Traffic signal	
	Stop sign	
	Yield sign	
	Pedestrian activated signal	
	Pedestrian crossing sign	
	Pedestrian overpass/underpass/bridge	
	None	

5. For an individual who is on this segment, how **safe (traffic wise)** do you think it is to cross the street from this segment?	not very safe/ unsafe	pretty safe/ very safe
6. For an individual who is on this segment, how **convenient (traffic wise)** do you think it is to cross the street from this segment?	not very convenient/ inconvenient	pretty convenient/ very convenient

Answer questions 7-11 while standing at the beginning of the segment

NEIGHBORHOOD IDENTIFICATION

7. Does the segment have **banners** that identify the neighborhood?	None	Few	Some/a lot

STREET CHARACTERISTICS

8a. Is this a **pedestrianized** street?	Yes	No
8b. Is the street a …	One-way	Two-way
9. Is this segment an **alley**?	Yes	No

10. How many **vehicle lanes** are there? (Include turning lanes)	1	2 or 3	4 or 5	6 or more	N/A (no lanes for car travel)

VIEWS

11a. Is this segment characterized by having **a significant open view** of an object or scene that is not on the segment? The view must be a prominent one.	Yes	No	
If 11a = No, mark box and skip to question 12.			☐
11b. How attractive is the open view?	Unattractive	Neutral	Attractive

Begin walking along segment to answer questions 12-68

LAND USES

	A			B
12a. What types of **land uses** are present on this area? Mark all that apply in column A.	Residential		Single family home – detached	
			Single family home/duplex – attached (2 units or fewer)	
			Town home/condo/apartment housing (3 units or more)	
			Mobile homes (includes manufactured homes)	
			Residential, other	
	School		Elementary, middle or junior high school	
			High school	
			University or college (includes all types of building forms)	
			School, other	
	Public space		Plaza, square, park, playground, landscaped open space, playing fields, garden	
			Public space, other	
	Recreational/leisure/fitness		Sports stadium, amusement park, zoo	
			Gym/fitness center (also includes yoga/pilates studios, etc.)	
			Movie theater	
			Recreational, other	
	Public/civic building		Community center and library	
			Museum, auditorium, concert hall, theater	
			Post office, police station, courthouse, Department of Motor Vehicles	
			Public building, other	
	Institutional		Religious institution (church, temple, mosque, etc.)	
			Hospital, medical facility, health clinic	
			Institutional, other	
	Commercial		Retail stores/restaurant	
			Bank/financial service	
			Hotel/hospitality	
			Car dealership	
			Gas/service station	
			Child care	
			Commercial, other	
	Office/service		Offices	
			Service facilities (includes insurance offices, funeral homes, dry cleaning, Laundromats, etc.	
			Office/service, other	
	Industrial/manufacturing		Light industrial (e.g. auto paint and auto body repair shops; i.e. clean industries)	
			Medium or heavy industrial (e.g. chemical plants, oil wells, etc)	
			Industrial, other	
	Transportation center		Transportation station/center (e.g. train or transit station, bus terminals, etc	
			Airport	
			Harbor/marina	
			Transportation, other	
	Other		Undeveloped land	
			Agricultural land, ranch, farming	
			Cemetery	
			Jail or prison	
			Parking lot/garage	
			Nature feature	
			Other	
			No predominant land use	

12b. In column B (above), mark which land use is **predominant**. Mark "no predominant land use" if there is no predominant land use.

If in 12a, you *only* marked that a residential land use was present, mark box and skip to question 16. ☐

12c. How many of the buildings in this segment contain **vertical-mixed use**, that is, the building has different land uses on different floors of the building?	None	Few	Some/ A lot	N/A (no bldgs. or all bldgs. = 1 story)

12d. Mark if any of these **building types** are present (focusing on the form of the building).	Big box shops (includes super stores or warehouse stores)	
	Shopping mall	
	Strip mall/row of shops	
	Drive-thru	
	None of the above	

If in 12a, you did *not* mark that public space was present, mark box and skip to question 14. ☐

13a. Mark off all types of **public space**(s) on this area.	Park/playground		Unattractive	Somewhat unattractive	Attractive
	Playing or sport field		Unattractive	Somewhat unattractive	Attractive
	Plaza /square /courtyard		Unattractive	Somewhat unattractive	Attractive
	Public garden		Unattractive	Somewhat unattractive	Attractive
	Beach		Unattractive	Somewhat unattractive	Attractive
	Other		Unattractive	Somewhat unattractive	Attractive

13b. For each public space marked, **how attractive** is it? Mark your response above.

If in 13a, you did *not* mark that a park/playground was present, mark box and skip to question 14. ☐

13c. For parks indicate the **scale**.	Neighborhood park	District park	Regional, State or National park

13d. Is it possible for the general public to **use the public space**(s)?	Yes	No	Unclear

OTHER LAND USES

14. How many of these **land uses** are present on this segment?	Bars/night clubs	None	Few	Some/A lot
	Adult uses	None	Few	Some/A lot
	Check cashing stores/pawn shops/bail bond stores	None	Few	Some/A lot
	Liquor stores	None	Few	Some/A lot

15. How many of the following **gathering places** are on this segment?	Restaurants	None	1 or few	Some/A lot
	Coffee shops	None	1 or few	Some/A lot
	Libraries/bookstores	None	1 or few	Some/A lot
	"Corner" store	None	1 or few	Some/A lot
	Art or craft galleries	None	1 or few	Some/A lot
	Farmers market	None	1 or few	Some/A lot

16. Are these **nature features** present on this segment?	Lake/pond	Yes	No
	Fountain/reflecting pool	Yes	No
	Stream/River/Canal/Creek	Yes	No
	Ocean	Yes	No
	Forest or woods	Yes	No
	Mountain or hills	Yes	No
	Desert	Yes	No

BARRIERS

		A	B		
17a. Are the following **barriers** present on this segment. Check all that apply. **Mark response in column A**.	Highway (elevated or below ground)		Yes	Somewhat	No
	Railroad track		Yes	Somewhat	No
	Impassable land use (e.g., gated community, major industrial complex, etc.)		Yes	Somewhat	No
17b. For each barrier checked, determine whether the **barrier can be overcome** (e.g. a pedestrian bridge would help overcome a 6-lane road). **Mark response in Column B.**	River		Yes	Somewhat	No
	Drainage ditches		Yes	Somewhat	No
	Fences/walls		Yes	Somewhat	No
	Road with 6 or more lanes		Yes	Somewhat	No
	Other		Yes	Somewhat	No
	None				

SIDEWALKS

18a. Are **sidewalks present** on both sides of this segment?	Both sides	One side	No sidewalk

If 18a = "No sidewalk", mark box and skip to question 19. ☐

18b. Is the **sidewalk complete** (on one or both sides)?	Complete	Incomplete

18c. What is the **predominant sidewalk width**? (If no predominant width, mark all that apply)	Under 4ft	4-7 ft	7+ ft

18d. What is the **condition** or maintenance of the sidewalk?	**Poor** (a lot of bumps, cracks, holes & weeds)	
	Moderate or good (little or no bumps, cracks, holes & weeds)	
	Under repair (sidewalk may be under construction or closed off for repairs	

18e. Is there a decorative or unique paving on that **covers most or all of the sidewalk** on the segment? (e.g., bricks, tile, etc.)	Yes	No

18f. Determine how much of the sidewalk is covered by these **features that provide protection** from sun, rain, and/or snow.	Arcades	No/little of sidewalk covered	Some/much of sidewalk covered
	Awnings	No/little of sidewalk covered	Some/much of sidewalk covered
	Other	No/little of sidewalk covered	Some/much of sidewalk covered

18g. Is there is a **buffer** (for example, parked cars, landscaped "buffer" strip, etc.) between sidewalk or street.	Buffer on both sides	Buffer on one side	No buffer

If 18g = "No buffer", mark box and skip to question 19. ☐

18h. Mark the **forms of buffers** that are present. Mark all that apply. **Buffers must be present along most or the entire segment – Do NOT have to be on both sides of the segment though)**	Angled parking of cars	
	Parallel parking of cars	
	Street trees that run along the most of or the entire segment and are between sidewalk and the street	
	Landscape "buffer" strip or bollards (posts) between sidewalk and street	
	Other	

19. Are there **sidewalks/greenbelts/trails/paths** other than sidewalks along street?	Yes	No

BICYCLE LANES

20a. Are there **bicycle lanes** on the segment?	Yes	No

If 20a = "No", mark box and skip to question 21. ☐

20b. How are the bicycle lanes **demarcated**?	On road, separated by painted line or reflectors	
	On road, physically separated from vehicle lanes (by curbs, etc.)	
	Off road	

MID BLOCK CROSSING

21a. Is there a **marked mid-block** crosswalk for pedestrians?	Yes	No

If 21a = No, mark box and skip to question 22. ☐

21b. What type of **marking** does the crosswalk have? Mark all that apply.	White painted lines	
	Colored painted lines	
	Zebra striping	
	Different road surface or paving (e.g. tiles, colored concrete, marble, etc)	
	Other	

STEEPNESS

22. How **steep** or hilly is this segment? Mark all that apply.	Flat or gentle	Moderate slope	Steep slope

SIDEWALK AMENITIES

23. Are there **outdoor dining areas** (e.g. cafes, outdoor tables at coffee shops or plazas, etc) located on the segment?	None	Few	Some/many

24a. Indicate how many of each of the following **street furniture/sidewalk amenities** is/are present on the segment.	Benches (not a bus stop), chairs and/or ledges for sitting	None	Few	Some/many
	Bus stops with seating	None	Few	Some/many
	Heat lamps	None	Few	Some/many
	Bike racks	None	Few	Some/many
	Trash cans	None	Few	Some/many

If 24a = "None" for all types of street furniture, mark here and skip to question 25. ☐

24b. Looking at the street furniture on this segment **overall**, would you describe it as generally **attractive**?	Yes	Somewhat/ Neutral	No

25. Are there obvious **public restrooms** on this segment that are **clearly open to the public**?	Yes	No

STREET TREES

26a. How many street trees are on this segment? (Do not include trees that are not on the public right of way; street trees are typically between the sidewalk and the street or if there is no sidewalk, trees usually line the street)	None/few trees	
	Some trees along the segment	
	Trees along most/entire segment	

If 26a = "None/few trees", mark box and skip to question 27. ☐

26b. Do trees create **shade on the street**?	No/little shade	Some/much shade	Full canopy of street trees

Look back to 18a. If 18a = "no sidewalk", mark box and skip to question 27. ☐

26c. Is the **sidewalk shaded** by trees?	Yes	Somewhat	No

BUILDINGS

27. What is the predominant amount that buildings are **setback** from the sidewalk (or from the street if no sidewalk)?	3 ft or less	4 - 10 ft	11 ft or more	No predominant setback	N/A (no buildings)

28. How many buildings on this segment can you **enter directly from the street**?	None/few	Most/all	N/A (no buildings)

29. What is the **predominant spacing** between the buildings on this segment?	No space left open between buildings (buildings are attached)	
	Some space left open between buildings (10 ft or less)	
	A lot of space between buildings (more than 10ft)	
	Spacing between buildings vary; no predominant spacing	
	N/A (no buildings/only one building)	

30. How many **stories** are most buildings on the segment?	1-2	3-4	5 or more	Heights vary, no predominant height	N/A (no buildings)

31. Are there **abandoned buildings or lots** on this segment?	None	One/few	Some/a lot

32a. Does at least **50% of the segment have buildings**?	Yes	No

If 32a = "No", mark box and skip to question 33.	

WINDOWS

32b. From how many buildings on the segment can **pedestrians easily be seen**?	Less than 50%	50% or more

33. How many buildings on this segment have **windows with bars**?	None or one	Few	Some/a lot	N/A (no windows/buildings)

OTHER FEATURES OF BUILDINGS

34. How many buildings on this segment have **front porches**?	None/few	Some/many	N/A (no buildings)
35. How many buildings on this segment have **balconies** facing the segment?	None/few	Some/many	N/A (no buildings)

36. How much of the segment has **blank walls or buildings with blank walls**?	None/little	Most/all

37a. On this segment, what percentage of the properties contain **fences/walls/hedges** that separate the building(s) or property(ies) from the street? (Hedges must be acting as fences/walls to be counted)	None	
	Less than 50%	
	50% or more	

If 37a = "none", mark box and skip to question 38a.	

37b. Describe the **attractiveness** overall of the walls and/or fences on this segment.	Unattractive	Neutral or attractive
37c. What is the approximate **height** of the fences/walls on the segment? Mark all that apply.	Less than 4 feet	4 feet and over

GARAGES

38a. How many buildings have **garage doors** facing the street?	None or one	Few	Some/many	N/A (no bldgs.)

If 38a = "none or one" or "N/A", mark box and skip to question 39a.	

38b. How **prominent** are most garage doors when looking at the front of the buildings?	Very or quite prominent	
	Somewhat prominent	
	Not very prominent or not visible from the front of the building	

PARKING

39a. Is there a **parking structure** visible on this segment (do not include parking structures that are completely underground)?	Yes	No

If 39a = "No" mark box and skip to question 40a.	

39b. Looking at the front of the parking structure on the street level floor, what is the **predominant use** that is visible to you?	Parking	Not parking (for example, shops, office, etc.)	Varied, no predominant use
39c. What percentage of the segment is covered by the parking structure?	All or almost all	About half	Less than half

40a. Is there a **parking lot** that fronts/faces the street on either side of the segment?	Neither side has a parking lot fronting the street	
	One side has a parking lot fronting the street	
	Both sides have parking lots fronting the street	

If 40a = "neither side has a parking lot", mark box and skip to question 41.	

40b. What is the **size** of the parking lot? (If more than one, choose size of the largest parking lot)	Small	Medium/large

40c. How much of the side(s) that has the parking lot fronting the street is(are) covered by the parking lot? (Consider the largest parking lot if more than one)	All or almost all	About half	Less than half
40d. How many **trees** are there in the parking lot, compared to the number of parking spaces?	None	Few	Some/many

DRIVEWAYS

41. How many **driveways** are visible on the segment?	None/few	Some/a lot	N/A (no buildings)

MAINTENANCE

42a. Describe the general **maintenance of the buildings** on this segment.	Bad/very bad	Good/very good	No buildings
42b. Describe the general **maintenance of the landscaping** on this segment.	Bad/very bad	Good/very good	No landscaping

If 42b = "Bad/very bad" or "No landscaping", mark box and skip to question 44.	☐

43. **How much** of the segment contains well-maintained (fair or good) landscaping?	Less than 50%	
	More than 50%	

44. How much **graffiti** is apparent on this segment?	None/Little	Some/a lot
45. How much **litter** is apparent on this segment?	None/Little	Some/a lot

46. Are there **dumpsters** visible on this segment?	None	Few	Some/many

47. Is there visible **electrical wiring** overhead on the segment?	Yes	No

LIGHTING

48a. Is there **outdoor lighting** on the segment? (Include lighting that is intended to light public paths and public spaces)	Yes	No

If 48a = "no", mark box and skip to question 49.	☐

48b. Are the outdoor light fixtures **mostly less than or greater than 13 feet** tall (i.e. one story)?	13 ft or less	More than 13 ft

48c. **How many** outdoor light fixtures are there on this segment?	3 or fewer	
	4 to 7	
	8 or more	

FREEWAYS

49. Is there a **freeway overpass/underpass** connected to this segment?	This segment is under a freeway overpass	
	This segment is next to a freeway	
	This segment is a freeway overpass	
	None of the above	

TRAFFIC FEATURES

50. What is the **posted speed limit** on this segment? Only include those on the segment itself.	Under 20 mph.	20-35 mph	36-50 mph.	Over 50 mph.	Not posted

51. Are there measures on this segment that could **slow down traffic**? Mark all that apply.	Speed bump/speed hump/raised crosswalk; or dips (that are intended to slow down traffic)	
	Rumble strips or bumps (includes dots, reflectors, raised concrete strips, etc.)	
	Curb bulb out/curb extension	
	Traffic circle/roundabout	
	Median	
	Street Trees (that run along most or the entire segment – do not have to be on both sides of segment)	
	Angled/ On-street parking (that runs along most or the entire segment - does not have to be on both sides of segment)	
	Other	
	None	

52a. Is there a **cul-de-sac or permanent street closing** on this segment?	Yes	No

If 52a = "No" mark box and skip to question 53.	☐

52b. Is there a **pedestrian access point** or cut through point that allows pedestrians to go from one segment to another even though vehicular traffic may not be able to)?	Yes	No	Don't Know

ARCHITECTURE/DESIGN

53. Rate the **attractiveness** of the segment.	Unattractive	Somewhat attractive	Attractive

54. Does this segment have buildings that appear to be **historic**?	Yes	No	N/A (no buildings)

55. How **interesting** is the architecture/urban design of this segment?	Not interesting	Somewhat interesting	Interesting
56. How **alike** are the designs of the buildings on the segment?	All of similar design	Range of different designs	N/A (no or 1 building)

If 56 = "All of similar designs" or "N/A" mark box and skip to question 58.	☐

57. How much do the houses or buildings appear to fit or **go together** (how compatible they are), in terms of architectural appearance? (Buildings do not have to be exactly the same to go together)	Not at all/ a little	
	Somewhat/a lot	
	N/A (no or 1 building)	

OTHER FEATURES OF THE SEGMENT

62. How many **street vendors or stalls** are on this segment? (may be selling food, newspapers and magazines, etc; may sell from carts, semi-permanent or permanent stalls, or directly on the sidewalk; do not count newspaper racks; there must be a person "manning" the stall)	None	Few	Some/ many

63. Is there **public art** that is visible on this segment?	Yes	No

64. Are there **billboards** present on this segment?	None/little	Some/a lot

PEOPLE

65. How many other **people** were present outdoors while you were observing this segment?	None	Some	A lot
If 65 = "None" mark box and skip to question 67.			

66. **Thinking of the people** on this segment, how **safe** do you feel walking on this segment **?**	Very safe/pretty safe	
	Not very safe/unsafe	

DOGS

67. Are there **any loose/unsupervised/barking dogs** on this segment that seem menacing?	Yes	No

OLFACTORY CHARACTER

68. Describe the **dominant smell** on the segment? Must be prevalent throughout the entire segment.	Pleasant smell	Unpleasant smell	No dominant smell

Answer questions 1-8 based on this end of the segment: Intersection of _______ and _______

NEIGHBORHOOD IDENTIFICATION

1. Are there **monuments or markers** including neighborhood entry signs that indicate that one is entering a special district or area? (Do not include park signs or other signs that do not indicate or demarcate a neighborhood or district)	Yes	No

STREET CROSSING

2a. Consider the places on the segment that are **intended** for pedestrians to cross the street. Are these places marked for pedestrian crossing?	All places where pedestrians can cross are marked for pedestrian crossing	
	Some of the places where pedestrians can cross are marked for pedestrian crossing	
	None of the places where pedestrians can cross are marked for pedestrian crossing	
	N/A (there is no street, or there are no places where pedestrian crossing is intended)	
If 2a = "None" or "N/A", mark box and skip to question 3.		
2b. What type of **marking** do the crosswalks have? Mark all that apply.	White painted lines	
	Colored painted lines	
	Zebra striping	
	Different road surface or paving (e.g. tiles, colored concrete, marble, etc)	
	Other	
3. Are there **curb cuts** at all places where crossing is expected to occur?	All expected crossing places have curb cuts	
	One or more expected crossing places are **missing** a curb cut(s)	
	N/A (no curbs or no expected crossing places)	
4. What type of **traffic/pedestrian signal(s)/system(s)** is/are provided? Mark all that apply.	Traffic signal	
	Stop sign	
	Yield sign	
	Pedestrian activated signal	
	Pedestrian crossing sign	
	Pedestrian overpass/underpass/bridge	
	None	

5. For an individual who is on this segment, how **safe (traffic wise)** do you think it is to cross the street from this segment?	not very safe/ unsafe	pretty safe/ very safe
6. For an individual who is on this segment, how **convenient (traffic wise)** do you think it is to cross the street from this segment?	not very convenient/ inconvenient	pretty convenient/ very convenient

SETTING: ______________________ OBSERVER __________ DATE __________

SETTING LEVEL QUESTIONS - IN-SITE OBSERVATIONS

Answer questions 1b-7 after observing all segments in the setting

1b. Which of these dominant land uses best describes this setting?	Residential	
	Mixed use	
	Other	

		A	B		
2a. Are the following barriers present in this setting. Check all that apply. Mark response in column A. 2b. For each barrier checked, determine whether the barrier can be overcome (eg. a pedestrian bridge would help overcome a 6-lane road). Mark response in Column B.	Highway (elevated or below ground)		Yes	Somewhat	No
	Railroad track		Yes	Somewhat	No
	Impassable land use (e.g., gated community, major industrial complex, etc.)		Yes	Somewhat	No
	River		Yes	Somewhat	No
	Drainage ditches		Yes	Somewhat	No
	Fences/walls		Yes	Somewhat	No
	Road with 6 or more lanes		Yes	Somewhat	No
	Other		Yes	Somewhat	No
	None				

3. Are there sidewalks/greenbelts/trails/paths other than sidewalks along street?	Yes	No
4. Does this setting have alleys?	Yes	No

5. Mark off all types of public space(s) in this setting.	Park/playground	
	Playing or sport field	
	Plaza /square /courtyard	
	Public garden	
	Other	
	None	

6. Are there monuments or markers including neighborhood entry signs that indicate that one is entering a special district or area? (Do not include park signs or other signs that do not indicate or demarcate a neighborhood or district)	Yes	No
7. Is there a railroad/railroad track present in this setting?	Yes	No

APPENDIX A.7: FACILITY INFORMATION QUESTIONNAIRE

Community Information

Date ____________________

Your name ____

1. Name of Community____
2. In what year was your campus started ____
3. Sponsoring agency or name of corporation ____
4. For <u>each level of care you offer</u>, please tell us how many units you have in total and how many of those units are occupied. (use "0" for those levels of care your campus does not offer)

	# of units total	# of units occupied
Nursing care		
Assisted living		
Independent living		

5. Do you consider your organization a CCRC (Continuing Care Retirement Community)?

   a. Yes
   b. No (*please skip to Q7*)

6. What type of contractual relationship between your community and residents exists that guarantees access to medical and nursing services as residents move between levels of care?

   a. Type A – extensive (lifetime); assisted living and skilled nursing costs included in basic fees
   b. Type B – modified; some lifetime care benefits covered through basic fees, while other benefits offered at an additional charge, as needed
   c. Type C – fee-for-service; all services offered are on a pay-as-you-go basis, at a rate specified by the provider
   d. No contract exists
   e. Other ____

7. For about what percentage of your independent living units do you provide government-subsidized housing?

   a. ____ %
   b. None (all units are at market rate)

8. Is there an initial entrance fee? ☐ Yes ☐ No
9. If so, what is the minimum entrance fee? ______________________

10. What is the minimum monthly fee in any of the apartments/homes?___________________

11. What services are covered by the monthly fee?

☐ Room and board ☐ Cleaning or maid service ☐ Meals

☐ Activities ☐ Personal Care ☐ Nursing care

☐ Other services ____

12. What is the minimum age for residents to be eligible at this facility?______________________

13. How many of each type of unit if present are available at this facility?

Studio apartments | Single family cottages

One-bedroom apartments | Duplex/cluster homes

Two-bedroom apartments

Three-bedroom apartments

Resident background characteristics

14. Please indicate how many of your **independent living** residents are male and female.
male # Female

15. How many of the **independent living** residents are

less than 65 years | 65 to 74 years

75 to 84 years | 85 and over

16. How many of the **independent living** residents are

Asian American | White

Black | Hispanic

Other

17. How many of the **independent living** residents come from the following educational backgrounds:

8^{th} grade or less | 9^{th} grade to 12^{th} grade

some post-high school education | some college

College graduate | graduate/professional degree

18. Indicate the number of present **independent living residents** who have been living in the facility

☐ less than 6 months ☐ 6 months to 1 year

☐ 1 to 3 years ☐ 3 to 5 years

☐ More than 5 years

19. Approximately how many independent living residents use:

Walkers | Wheelchairs

Canes | Amigos/ golf carts

Resident Participation

20. Are any of the residents hired and paid for jobs within the facility? ☐ Yes ☐ No
21. Do any of the residents have other types of chores or duties (unpaid) that they perform here?

    ☐ Yes ☐ No
22. If so, how many residents participate? ____________________
23. Is there a residents' council? ____________________
24. If so, how many residents are on it? ____________________
25. How often does it meet?

    ☐ Once a week or more

    ☐ Twice a month

    ☐ Once a month or less
26. Are there regular house meetings for residents (a general meeting open to all residents)?

    ☐ yes ☐ No
27. If so, how often do they occur?

    ☐ Twice a month or more ☐ Less than a month

    ☐ Once a month ☐ Only when needed
28. Are there resident committees (or committees that include residents as members)?

    ☐ Yes ☐ No
29. If so, list the most important committees and the number of residents on each.

Committee name	Number of residents
____________________	__________
____________________	__________
____________________	__________
____________________	__________

30. Is there a newsletter?
31. If so, how often is it printed?

    ☐ Once a week or more

    ☐ Twice a month

    ☐ Once a month

    ☐ Less than once a month

32. If so, is it primarily written by residents? ☐ yes ☐ No

Decision making

33. To what extent are residents involved in policy making in the following areas? Please check boxes that are applicable.

Areas	Staff/ administration basically decide by themselves	Staff/ administration decide but residents have input	Residents decide but staff has input	Residents basically decide by themselves
Planning entertainment such as movies or parties				
Planning educational activities such as courses or lectures				
Planning welcome or orientation activities				
Deciding what kinds of new activities or programs will occur				
Making rules about attendance at activities				
Planning daily or weekly menus				
Setting mealtimes				
Deciding on the décor of public areas				
Dealing with safety hazards				
Dealing with residents' complaints				
Making rules about the use of alcohol				
Selecting new residents				
Deciding when a troublesome or sick resident will be asked to leave				
Moving a resident from one room to another				
Changes in staff (hiring or firing)				

Services and amenities available

34. Please indicate which of the following services are provided by this facility.

Service	Yes	No
Regularly scheduled doctor's hours		
Doctor on call		
Regularly scheduled nurse's hours		
Assistance in using prescribed medications		
On site medical clinic		
Physical therapy		
Occupational therapy		
Exercise facility/ fitness center		
Exercise room with equipment		
Psychotherapy or personal counseling		
Religious advice or counseling		
Legal advice or counseling		
Assistance with banking or other matters		
Assistance with housekeeping or cleaning		
Assistance with preparing meals		
Assistance with personal care or grooming		
Barber or beauty service		
Assistance with laundry or linen service		
Assistance with shopping		
Providing transportation		

Activities

35. For each activity that takes place in your community, indicate the frequency of occurrence (check box that is applicanble)

Activity	**Very rarely or never**	**Only a few times a year**	**Once or twice a month**	**Once a week or more**
Exercise or other physical fitness activity				
Outside entertainment (e.g. pianist or singer)				
Discussion groups				
Reality orientation groups				
Self-help or mutual support groups				
Films or movies				
Club, social group or drama or singing groups				
Classes or lectures				
Bingo, cards or other games				
Parties				
Religious services				
Social hour (e.g. coffee or cocktail hour)				
Arts and crafts				

36. Do you collect any data about physical activity among residents? ☐ Yes ☐ No

37. What type of physical activity data do you collect?

____
____
____
____
____

38. How many other staff members have it in their job description to plan, schedule, or staff organized physical activity opportunities on your campus? (e.g. fitness instructors, etc.)

Part-time (30 hours or less) ______
Full-time ______

39. In terms of physical activity facilities and activities, how would you rate your community?

☐ Excellent - We have all the latest and greatest activities and facilities
☐ Good – Our facilities and activities are good, but not state-of-the-art
☐ Average – Our facilities and activities are okay, could use some improvements in the near future
☐ Below Average – We need to improve and upgrade our activities and facilities

APPENDIX B: PATH USE FREQUENCY DISTRIBUTIONS

PATH SEGMENT USE AT PS

Table B.1: Path segment use for walking to destinations at PS

Number of times path segments were chosen for walking to destinations	Number of path segments	Cumulative Percent
0	152	58.9
1	6	61.2
2	20	69.0
3	1	69.4
4	31	81.4
5	1	81.8
6	4	83.3
7	1	83.7
8	14	89.1
10	3	90.3
12	5	92.2
14	3	93.4
16	6	95.7
18	1	96.1
20	1	96.5
24	1	96.9
28	1	97.3
38	1	97.7
40	1	98.1
44	1	98.4
59	1	98.8
62	1	99.2
65	1	99.6
80	1	100.0
Total	258	

Table B.2: Path segment use for walking for recreation at PS

Number of times the segment was chosen for recreational walking		Number of paths	Percent	Cumulative Percent
Valid	0	76	29.5	29.5
	1	25	9.7	39.1
	2	30	11.6	50.8
	3	23	8.9	59.7

4	15	5.8	65.5
5	12	4.7	70.2
6	10	3.9	74.0
7	7	2.7	76.7
8	4	1.6	78.3
9	8	3.1	81.4
10	6	2.3	83.7
11	9	3.5	87.2
12	5	1.9	89.1
13	3	1.2	90.3
14	3	1.2	91.5
15	2	.8	92.2
16	4	1.6	93.8
17	2	.8	94.6
18	4	1.6	96.1
19	1	.4	96.5
20	1	.4	96.9
31	3	1.2	98.1
32	3	1.2	99.2
33	1	.4	99.6
38	1	.4	100.0
Total	258	100.0	

PATH SEGMENT USE AT LV

Table B.3: Path segment use for walking to destinations at LV

Number of times the segment was chosen for walking to destinations		Number of path segments	Percent	Cumulative Percent
Valid	0	199	72.4	72.4
	1	5	1.8	74.2
	2	24	8.7	82.9
	3	2	.7	83.6
	4	6	2.2	85.8
	5	7	2.5	88.4
	6	5	1.8	90.2
	8	7	2.5	92.7
	9	1	.4	93.1
	10	5	1.8	94.9
	14	3	1.1	96.0
	20	2	.7	96.7
	49	1	.4	97.1
	50	1	.4	97.5

	56	1	.4	97.8
	60	3	1.1	98.9
	61	1	.4	99.3
	62	1	.4	99.6
	64	1	.4	100.0
	Total	275	100.0	

Table B.4: Path segment use for recreational walking at LV

Number of times the segment was chosen for recreational walking		Number of path segments	Percent	Cumulative Percent
Valid	0	59	21.5	21.5
	1	36	13.1	34.5
	2	41	14.9	49.5
	3	10	3.6	53.1
	4	20	7.3	60.4
	5	13	4.7	65.1
	6	20	7.3	72.4
	7	12	4.4	76.7
	8	13	4.7	81.5
	9	6	2.2	83.6
	10	2	.7	84.4
	11	1	.4	84.7
	12	3	1.1	85.8
	13	4	1.5	87.3
	14	5	1.8	89.1
	15	2	.7	89.8
	16	3	1.1	90.9
	17	2	.7	91.6
	18	7	2.5	94.2
	19	2	.7	94.9
	20	2	.7	95.6
	21	1	.4	96.0
	22	2	.7	96.7
	25	1	.4	97.1
	26	1	.4	97.5
	32	1	.4	97.8
	34	3	1.1	98.9
	36	2	.7	99.6
	37	1	.4	100.0
	Total	275	100.0	

PATH SEGMENT USE AT PV

Table B.5: Path segment use for walking to destinations at PV

Number of times the segment was chosen for walking to destinations		Number of path segments	Percent	Cumulative Percent
Valid	0	52	50.5	50.5
	1	7	6.8	57.3
	2	8	7.8	65.0
	3	3	2.9	68.0
	4	2	1.9	69.9
	5	1	1.0	70.9
	6	3	2.9	73.8
	7	1	1.0	74.8
	8	2	1.9	76.7
	9	1	1.0	77.7
	10	2	1.9	79.6
	11	2	1.9	81.6
	12	2	1.9	83.5
	13	2	1.9	85.4
	14	2	1.9	87.4
	15	1	1.0	88.3
	17	3	2.9	91.3
	18	1	1.0	92.2
	23	1	1.0	93.2
	24	2	1.9	95.1
	26	1	1.0	96.1
	28	1	1.0	97.1
	30	1	1.0	98.1
	31	1	1.0	99.0
	34	1	1.0	100.0
	Total	103	100.0	

Table B.6: Path segment use for walking for recreation at PV

Number of times the segment was chosen for recreational walking		Number of path segments	Percent	Cumulative Percent
Valid	0	59	57.3	57.3
	1	4	3.9	61.2
	2	2	1.9	63.1

3	4	3.9	67.0
5	5	4.9	71.8
6	1	1.0	72.8
7	1	1.0	73.8
8	3	2.9	76.7
9	1	1.0	77.7
10	1	1.0	78.6
12	4	3.9	82.5
13	1	1.0	83.5
14	3	2.9	86.4
15	1	1.0	87.4
16	3	2.9	90.3
17	3	2.9	93.2
18	1	1.0	94.2
19	1	1.0	95.1
21	2	1.9	97.1
22	1	1.0	98.1
24	1	1.0	99.0
35	1	1.0	100.0
Total	103	100.0	

REFERENCES CITED

AAHSA. (2005). *The continuing care retirement communities 2004 profile*. Washington, DC: American Association of Homes and Services for the Aging (AAHSA).

Bafna, S. (2003). Space Syntax: A brief introduction to its logic and analytical techniques. *Environment & Behavior, 35*(1), 17-29.

Bafna, S., & Zhang, Z. (2005). Space Syntax application extension to GIS software. Atlanta.

Ball, K., Bauman, A., Leslie, E., & Owen, N. (2001). Perceived Environmental Aesthetics and Convenience and Company Are Associated with Walking for Exercise among Australian Adults. *Preventive Medicine, 33*(5), 434-440.

Barker, R. (1968). *Ecological Psychology: concepts and methods for studying the environment of human behavior*. Stanford, CA: Stanford University Press.

Batagelj, V., & Mrvar, A. (2003). Pajek - Analysis and Visualization of Large Networks. In M. Jünger, Mutzel, P (Ed.), *Graph Drawing Software* (pp. 77-103). Berlin: Springer.

Berrigan, D., & Troiano, R. P. (2002). The Association Between Urban Form and Physical Activity in U.S. Adults. *American Journal of Preventive Medicine, 23*(2S), 74-79.

Boarnet, M., Day, K., Alfonzo, M., Forsyth, A., & Oakes, M. (2006 (forthcoming)). The Irvine Minnesota Inventory to Measure Built Environments for Active Living (II). *American Journal of Preventive Medicine.*

Booth, M. L. (2000). Assessment of physical activity: An international perspective. *Research Quarterly for Exercise and Sport, 71*(2), 114-120.

Booth, M. L., Owen, N., Bauman, A., Clavisi, O., & Leslie, E. (2000). Social-Cognitive and Perceived Environment Influences Associated with Physical Activity in Older Australians. *Preventive Medicine, 31*(1), 15-22.

Boutelle, K., Jeffrey, R. W., Murray, D. M., & Schmitz, K. (2001). Using signs, artwork and music to promote stair use in a public building. *American Journal of Public Health, 91*(12), 2004-2006.

Bronfenbrenner, U. (1992). Ecological systems theory. In R. Vasta (Ed.), *Six theories of child development: revised formulations and current issues* (pp. 187-249). London: Jessica Kingsley Publishers.

Brownson, R., Housemann, R. A., Brown, D. R., Jackson-Thompson, J., King, A. C., Malone, B. R., et al. (2000). Promoting Physical Activity in Rural Communities: Walking Trail Access, Use, and Effects. *American Journal of Preventive Medicine, 18*(3), 235-241.

Brownson, R. C., Eyler, A. A., King, A. C., Brown, D. R., & al, e. (2000). Patterns and correlates of physical activity among US women 40 years and older. *American Journal of Public Health, 90*(2), 264.

Carnegie, M. A. B., A. Marshall, A.L. Mohsin, M. Westley-Wise, V. Booth, M.L. (2002). Perceptions of the Physical Environment, Stage of Change for Physical Activity, and Walking Among Australian Adults. *Research Quarterly for Exercise & Sport, 73*(2), 146.

CDC. (1999). Neighborhood Safety and the Prevalence of Physical Inactivity -- Selected States, 1996. *Morbidity and Mortality Weekly Report, 48*(7), 143-146.

Clark, D. O. (1999). Physical activity and its correlates among urban primary care patients aged 55 years or older. *Journals of Gerontology Series B: Psychological Sciences & Social Sciences, 54B*(1), S41.

Coleman, K. J., & Gonzalez, E. C. (2001). Promoting Stair Use in a US–Mexico Border Community. *American Journal of Public Health, 91*(12), 2007-2009.

Day, K., Boarnet, M., Alfonzo, M., & Forsyth, A. (2006 (forthcoming)). The Irvine Minnesota Inventory to Measure Built Environments for Active Living (I). *American Journal of Preventive Medicine.*

Feskanich, D., Willett, W., & Colditz, G. (2002). Walking and leisure-time activity and risk of hip fracture in postmenopausal women. *The Journal of the American Medical Association, 288*(18), 2300-2306.

Giles-Corti, B., Broomhall, M. H., Knuiman, M., Collins, C., Douglas, K., Ng, K., et al. (2005). Increasing walking: How important is distance to, attractiveness, and size of public open space? *American Journal of Preventive Medicine, 28*(2, Supplement 2), 169-176.

Giles-Corti, B., & Donovan, R. J. (2002). The relative influence of individual, social and physical environment determinants of physical activity. *Social Science & Medicine, 54*(12), 1793-1812.

Hamdorf, P., Starr, G., & Williams, M. (2002). A Survey of Physical Activity Levels and Functional Capacity in Older Adults in South Australia. *Journal of Aging and Physical Activity, 10*, 281-289.

Handy, S. L., Boarnet, M. G., Ewing, R., & Killingsworth, R. E. (2002). How the Built Environment Affects Physical Activity: Views from Urban Planning. *American Journal of Preventive Medicine, 23*(2s), 64-73.

Haq, S., & Zimring, C. (2003). Just down the road a piece: The development of topological knowledge of building layouts. *Environment & Behavior, 35*(1), 132-160.

Harris-Kojetin, L., Kiefer, K., Joseph, A., & Zimring, C. (2005). Encouraging physical activity among retirement community residents - the role of campus commitment, programming, staffing, promotion, financing and accreditation. *Senior Housing and Care Journal, 13*(1), 3-20.

Henderson, K. A., & Ainsworth, B. E. (2000). Enablers and constraints to walking for older African American and American Indian women: The cultural activity participation study. *Research Quarterly for Exercise and Sport, 71*(4), 313-321.

Hilleras, P. K., Jorm, A. F., Herlitz, A., & Winblad, B. (1999). Activity Patterns in very old people: A survey of cognitively intact subjects aged 90 years or older. *Age and Ageing, 28*(2), 147-152.

Hillier, B. (1996). *Space is the machine*. Cambridge, UK: Cambridge University Press.

Howell, S. (1980). *Designing for aging : patterns of use*. Cambridge, Mass.: MIT Press.

Humpel, N., Owen, N., Iverson, D., Leslie, E., & Bauman, A. (2004). Perceived environment attributes, residential location, and walking for particular purposes. *American Journal of Preventive Medicine, 26*(2), 119-125.

Humpel, N., Owen, N., & Leslie, E. (2002). Environmental factors associated with adults' participation in physical activity: A review. *American Journal of Preventive Medicine, 22*(3), 188-199.

Joseph, A., & Kiefer, K. (2004). *Phase 1 deliverable: Literature review and informational interviews.* Washington DC: Robert Wood Johnson Foundation.

Joseph, A., Zimring, C., Harris-Kojetin, L., & Kiefer, K. (2006 (forthcoming)). Presence and visibility of outdoor and indoor physical activity features and participation in physical activity among older adults in retirement communities. *Journal of Housing for the Elderly*.

Kerr, N. A., Yore, M. M., Ham, S. A., & Dietz, W. H. (2004). Increasing Stair Use in a Worksite Through Environmental Changes, *American Journal of Health Promotion* (Vol. 18, pp. 312-315)

King, A. C. (2001). Interventions to promote physical activity by older adults. *The Journals of Gerontology, 56a*(Supplement: Nutrition, Physical Activity, and Quality of Life in...), 34-46.

King, A. C., Rejeski, W. J., & Buchner, D. M. (1998). Physical Activity Interventions Targeting Older Adults: A Critical Review and Recommendations. *American Journal of Preventive Medicine, 15*(4), 316-333.

King, W. C., Brach, J. S., Belle, S., Killingsworth, R., Fenton, M., & Kriska, A. M. (2003). The Relationship Between Convenience of Destinations and Walking Levels in Older Women., *American Journal of Health Promotion* (Vol. 18, pp. 74-82): American Journal of Health Promotion.

Krebs, V. (2005). *An introduction to social networks analysis*. Retrieved 1/25/06, 2006, from http://www.orgnet.com/sna.html

Lawton, M. P. (1982). Competence, Environmental Press and the Adaptation of Older People. In M. P. Lawton, P. G. Windley & T. O. Byerts (Eds.), *Aging and the Environment: Theoretical Approaches*. New York: Springer Publishing Company Inc.

Lemke, S. & Moos, R. (1989). Personal and Environmental Determinants of Activity Involvement Among Elderly Residents of Congregate Living Facilities. *Journal of Gerontolgy, 44*(4), S139-148.

Leveille, S. (1999). Aging successfully until death in old age: opportunities for increasing active life expectancy. *American Journal of Epidemiology, 149*, 654-664.

Nooy, W. d., Mrvar, A., & Batagelj, V. (2005). *Exploratory Social Network Analysis with Pajek*. Cambridge: Cambridge University Press.

Miller, M. (2000). Physical Activity, functional limitations and disability in older adults. *Journal of the American Geriatric Society, 48*, 1264-1272.

Moos, R. H., & Lemke, S. (1996). *Evaluating Residential Facilities: The Multiphasic Environmental Assessment Procedure*: Sage Publications.

Moudon, A. V., & Lee, C. (2003). Walking and Bicycling: An Evaluation of Environmental Audit Instruments., *American Journal of Health Promotion* (Vol. 18, pp. 21-37)

Parker, D., & Joseph, A. (2003). *Creating environments to promote physical activity among older adults.* Paper presented at the EDRA 34/2003 People Shaping Places Shaping People, Minneapolis.

Pate, R. R. P., Michael. (1995). Physical activity and public health., *JAMA: Journal of the American Medical Association* (Vol. 273, pp. 402): American Medical Association.

Peatross, F. (1995). *The Spatial dimensions of control in restricted settings.* Unpublished Ph.D., Georgia Institute of Technology, Atlanta.

Peponis, J., & Wineman, J. (2002). The spatial structure of environment and behavior: Space syntax. In R. Bechtel & A. Churchman (Eds.), *Handbook of environmental psychology*. New York: John Wiley.

Pikora, T. J., Bull, F. C. L., Jamrozik, K., Knuiman, M., Giles-Corti, B., & Donovan, R. J. (2002). Developing a reliable audit instrument to measure the physical environment for physical activity. *American Journal of Preventive Medicine, 23*(3), 187-194.

Powell, K. E. (2005). Land use, the built environment, and physical activity: A public health mixture; a public health solution. *American Journal of Preventive Medicine, 28*(2, Supplement 2), 216-217.

Regnier, V. (1994). *Assisted living housing for the elderly : design innovations from the United States and Europe*. New York: Van Nostrand Reinhold.

Regnier, V. (2002). *Design for assisted living: Guidelines for housing the physically and mentally frail*. New York: John Wiley & Sons.

Saelens, B. E. S., James F. Black, Jennifer B. Chen, Diana. (2003). Neighborhood-Based Differences in Physical Activity: An Environment Scale Evaluation., *American Journal of Public Health* (Vol. 93, pp. 1552): American Public Health Association.

Sallis, J. F., Kraft, K., & Linton, L. S. (2002). How the environment shapes physical activity: A transdisciplinary research agenda. *American Journal of Preventive Medicine, 22*(3), 208.

Satariano, W. A., & McAuley, Edward. (2003). Promoting physical activity among older adults: From ecology to the individual. *American Journal of Preventive Medicine, 25*(3, Supplement 2), 184-192.

Shephard, R. J. (1997). *Aging, physical activity, and health*. Champaign, IL: Human Kinetics.

Shi, L., & Singh, D. (2001). *Delivering Health Care in America: A Systems Approach* (2nd ed.). Gaithersburg, Maryland: Aspen Publishers.

Stewart, A. L., Mills, K. M., King, A. C., Haskell, W. L., Gillis, D., & Ritter, P. L. (2001). CHAMPS Physical Activity Questionnaire for Older Adults: outcomes for interventions. *Medicine and Science in Sports and Exercise*, *33*(7), 1126-1141

Stokols, D. (1987). Conceptual strategies of environmental psychology. In D. Stokols & I. Altman (Eds.), *Handbook of Environmental Psychology* (pp. 41-70). New York: John Wiley & Sons.

Stokols, D., Grzywacz, J. G., McMahan, S., & Phillips, K. (2003). Increasing the Health Promotive Capacity of Human Environments., *American Journal of Health Promotion* (Vol. 18, pp. 4-13): American Journal of Health Promotion.

Takano, T., Nakamura, K., & Watanabe, M. (2002). Urban residential environments and senior citizens' longevity in megacity areas: the importance of walkable green spaces. *Journal of Epidemiology and Community Health, 56*, 913-918.

Tudor-Locke, C., Jones, G. R., Myers, A. M., Paterson, D. H., & Ecclestone, N. (2002). Contribution of structured exercise class participation and informal walking for exercise to daily physical activity in community-dwelling older adults. *Research Quarterly for Exercise and Sport, 73*(3), 350-356.

USDHHS. (1996). *Physical activity and health: a report of the Surgeon General.* Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion.

Wilcox, S., Castro, C., King, A. C., Housemann, R., & Brownson, R. C. (2000). Determinants of leisure time physical activity in rural compared with urban older and ethnically diverse women in the United States. *Journal of Epidemiology and Community Health, 54*, 667-672.

Zimring, C., Joseph, A., Nicoll, G. L., & Tsepas, S. (2005). Influences of building design and site design on physical activity: Research and intervention opportunities. *American Journal of Preventive Medicine, 28*(2, Supplement 2), 186-193.